THE ENGINEER

A Seven-Day Journal

The Iron and Steel Institute Dinner

A COMPANY of over 700 members and guests attended the annual dinner of the Iron and Steel Institute, which was held at the Dorchester Hotel, London, on Wednesday evening of last week. The newly elected President of the Institute, Mr. Richard Mather, was in the chair. The toast of "The Iron and Steel Institute and Industry" was proposed by Lord Bruce of Melbourne, who emphasised the international character of the Institute. International co-operation, he said, was a vital need of industry to-day in the strange world in which we were living, and that co-operation was more essential in the iron and steel industry than in any other. Iron and steel were an imperative requirement to build up the defences of the free world for the maintenance of peace, and were the basis of economic and social progress. If raw material supplies were available, Lord Bruce continued, the contemplated world output of crude steel in 1953 would be 240,000,000 tons, of which this country aimed to produce 18,000,000 tons. If the figure of 240,000,000 tons could be achieved, it was essential, Lord Bruce suggested, to consider what the effect would be. The Economic Commission for Europe had recently stated that, in the absence of the abnormal demand for steel created by re-armament, Europe alone would have a steel surplus of about 8,000,000 tons in 1953, for which no export outlets could be seen. That, Lord Bruce said, was a matter which must be considered by the steel industry of the world. After a response by the President, the toast of "The Guests" was proposed by Captain H. Leighton-Davies, Vice-President, and acknowledged by Dr. A. J. Clasen, Minister Plenipotentiary for the Grand Duchy of Luxembourg.

Organisation of the Water Supply Industry

THE British Waterworks Association has published a report of a sub-committee which it appointed in October, 1949, "to consider what alterations, if any, may be necessary to ensure the efficiency of the organisation of the water industry of the country and to secure as far as possible a complete supply of water for all persons in the United Kingdom." The report recommends the formation of "a co-ordinating body with general jurisdiction, but not ownership, of the water supply industry," which, it is suggested, should be appointed by the Minister of Local Government and Planning and answerable to him, although it would not be part of the Ministry. The proposed organisation would number among its functions the collation of information about water resources, help to regional joint advisory committees and individual water authorities and, perhaps, reallocation of existing sources of supply. Also suggested was the initiation of water supply schemes and the setting up of joint boards for the development of water resources where these measures might prove necessary. Finally, it was thought that recommendations should be submitted to the Central Advisory Water Committee, from time to time, on improvements in the law affecting water resources and supplies. The report states that the problem of rural water supplies is not so extensive as is commonly supposed and much has been achieved. Schemes now being carried out and proposed schemes should "break the back" of the problem. Other recommendations include the setting up of regional joint advisory water committees and the encouragement and implementation of measures of uniformity, such as the British Waterworks Association is already doing, for by-laws and fittings through the Standing Committee on Water Regulations. The committee also considers that the consumer should be able to look to the local water authority for advice and help in everything affecting water supply and recommends that every authority should provide consumer service.

The Road Fund Report

THE Report on the Administration of the Road Fund for 1949–50, which was published last week by H.M. Stationery Office, shows that payments from the fund during the year for the maintenance, improvement and construction of roads totalled nearly £26,000,000, compared with £23,500,000 in 1948–49. Of that total, the amount paid out in respect of trunk roads was £9,215,000. Maintenance work and minor improvement of trunk roads cost £6,868,000, and improvement and new construction required £1,963,000. Grants from the fund to highway authorities last year totalled £15,923,000, compared with £14,804,000 in the preceding twelve months. The report says that the 1949–50 programme of road improvement and new construction work was somewhat larger than that for 1948–49, but when the investment limit for 1950 was fixed in mid-1949 it was seen that the programme would entail a bigger consequential expenditure than the financial limit would allow. Authorisation of new works was therefore restricted, and towards the end of 1949 the road improvement programme was again curtailed. The report records that, throughout the year 1949–50, the beginning of new improvement works and new road construction was for the most part confined to schemes which were indispensable to the continuance of essential communications or to other parts of the national investment programme. But a limited amount of work was undertaken to improve conditions at some of the worst danger spots on this country's roads.

Tercentenary of Hay's Wharf

HAY'S Wharf, London Bridge, the oldest and largest of the wharves in the Port of London, celebrated its tercentenary last week. It was established in April, 1651, when Alexander Hay took over a small wharf on the Thames near London Bridge, and in an Elizabethan building, formerly used as a granary, set up in business as a brewer and wharfinger. But Hay evidently found that wharfingering and warehousing were more profitable than brewing, and let the brewery so that he might concentrate on the business of the wharf. At first, no more than one "Bylander" or coaster and two or three sailing barges berthed at the wharf each week, bringing tallow and fats from East Anglia for the soapboilers and chandlers, and hides and skins from the West Country and Southern Ireland for the Bermondsey tanners. In 1656, Hay let part of the wharf and buildings to the New River Company, and for some years there was carried on the work of hollowing out elm trees for providing London's early water mains. In official records the wharf became known as "Pipe Boarers' Wharf," a designation which remained until the end of the eighteenth century, although pipe boring at the wharf ceased at the beginning of that century. To commemorate the tercentenary, the Proprietors of Hay's Wharf, Ltd., have produced an interesting illustrated brochure, entitled "Three Hundred Years on London River," which records the principal points of the wharf's history and recalls how the business steadily broadened from coastal to overseas trade, the latter development beginning with the arrival in 1862 of Jardine's famous clippers bringing tea from China. The brochure also notes that Shackleton's "Quest" fitted out in Hay's Dock in 1921, before leaving on her last tragic voyage to the South Pole. To-day, the company's wharves have a three-quarter-mile frontage to the river, and, in contrast to the few small coastal craft unloaded by wooden hand cranes at Alexander Hay's wharf, there is modern mechanical and electrical equipment dealing with as many as twenty ships a week, some of 6000 gross tons.

Tyneside Industrial Exhibition

THE Tyneside Industrial Exhibition was opened at the Stephenson Building, Newcastle upon Tyne by the Lord Mayor on Tuesday, May 29th, as part of the Festival of Britain celebrations. The exhibition, which is housed in the Stephenson Building, the Palace of Industry and the Municipal Museum of Science and Industry, is primarily for local manufacturers, and will continue until June 17th. H.R.H. the Duke of Edinburgh will officially open the Stephenson Building of King's College in October next, but those parts now completed are being put into service. Three enclosed halls contain engineering exhibits, and the large basement laboratory is devoted to the display of working and static mining exhibits, including mining machinery, mine lighting and switchgear, and a section concerned with safety in mines. The display in the halls also covers ships' auxiliary machinery, glass machinery, gas appliances, switchgear and electronic devices. On an adjacent site there is an exhibition of outdoor equipment, consisting of road rollers, electric vehicles and field workshops. The industrial section, which is the largest part of the exhibition, is housed in a temporary structure of tubular steel and canvas, some 700ft long by 50ft wide, erected on parkland adjoining the Stephenson Building. There are displays by local manufacturers, the Army and Navy and institutions such as St. John Ambulance and the Royal National Lifeboat Institution.

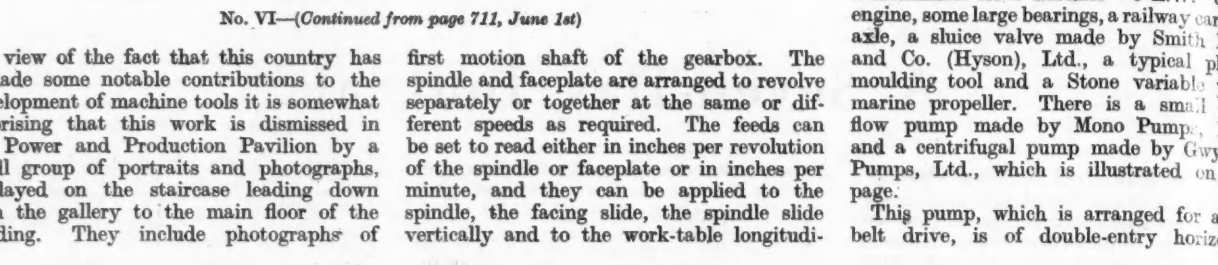
Courses for Instrument Maintenance Mechanics

THE City and Guilds of London Institute has announced the adoption of a new scheme of courses and examinations in instrument maintenance, which has been drawn up by an authoritative advisory committee, including representatives of industry, the Society of Instrument Technology, the Ministries of Supply, Fuel and Power, and Education, the Service Departments, major engineering professional institutions, and associations concerned with technical education. It is stated that the scheme is intended to meet the needs of mechanics and technicians concerned in the maintenance, repair and installation of the instruments used for process and production control in industrial plants and in H.M. Forces. Particular attention is being given to the requirements of the chemical, iron and steel and petroleum industries, to fuel economy and the needs of the Services, but the structure of the scheme is such that it will be found to have wide application. The course of part-time study is of five years' duration with an intermediate examination at the end of the third year, and a final examination at the end of the fifth year. There is provision for students holding an appropriate Ordinary National Certificate to enter the course at the beginning of the fourth year. Courses to be provided under the new scheme will be available in technical colleges and it is hoped they will go a long way to ensure the proper training and education of instrument maintenance mechanics.

The South Bank Exhibition

No. VI—(*Continued from page 711, June 1st*)

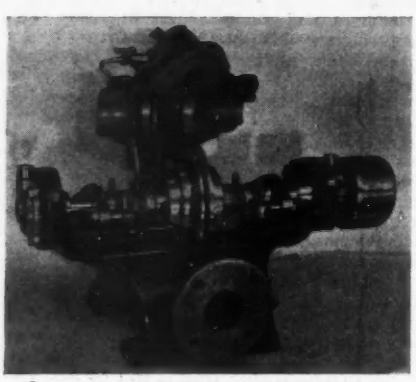
IN view of the fact that this country has made some notable contributions to the development of machine tools it is somewhat surprising that this work is dismissed in the Power and Production Pavilion by a small group of portraits and photographs, displayed on the staircase leading down from the gallery to the main floor of the building. They include photographs of Richard Roberts with his back-geared lathe of 1817; Henry Maudslay and his screw-cutting lathe; Joseph Clement and his planing machine, and Sir Joseph Whitworth and his measuring machine of 1855.



16-INCH HIGH SPEED LATHE

The modern machine tool is represented by the horizontal boring machine, illustrated on Plate 1 in last week's issue of THE ENGINEER, and by the 16in high-speed lathe, which we illustrate on this page. Both of these machines, which are shown in operation, were made by Craven Brothers (Manchester), Ltd., Reddish, Stockport.

The moving table, fixed column, boring machine has a two-shear main bed, the left-hand end of which is widened to form a broad base for the massive column. Wide, square-section, vertical slideways on the column carry the spindle slide, which is balanced by a weight housed in the column.



CENTRIFUGAL PUMP

The spindle slide, in addition to the spindle and its drive, contains all the speed and feed changing gear and a flange-mounted main driving motor directly coupled to the first motion shaft of the gearbox. The spindle and faceplate are arranged to revolve separately or together at the same or different speeds as required. The feeds can be set to read either in inches per revolution of the spindle or faceplate or in inches per minute, and they can be applied to the spindle, the facing slide, the spindle slide vertically and to the work-table longitudinally or transversely. Each of the motions has a quick power traverse.

The 3½in diameter spindle has a horizontal traverse of 32in at one setting or 46in at two settings and, when driven by a constant speed motor, has twenty speeds from 5 to 400 r.p.m., with twelve faceplate speeds of from 5 to 63 r.p.m. Eighteen boring feeds from 0·0009in to 0·25in per revolution of the spindle or faceplate are available and the same number of facing feeds from 0·001in to 0·32in per revolution of the faceplate.

The Craven standard 16in centres high-speed, sliding, surfacing and screwcutting lathe, which is shown turning heavy shafts and spindles, is illustrated on this page.

In this machine ample power for all normal requirements is provided by a constant speed reversing 20 h.p. motor, the drive of which is transmitted through multiple vee belts to the first motion shaft in the headstock. The sixteen spindle speeds, from 4 to 400 r.p.m., provide an effective range for using either high-speed or carbide-tipped tools on the machine. Heavy roller journal races carry the front bearing neck and the rear neck is fitted with a pair of opposed combined radial and single-direction thrust ball bearings which take the axial cutting loads.

The well-proportioned saddle, compound swivel slide-rest and revolving turret tool-post give a high degree of support to the cutting tools. An eight-change feed gear-box in the saddle apron gives sliding feeds from 0·01in to 0·06in per revolution of the spindle and surfacing feeds from 0·02in to 0·12in per revolution of the spindle. A 1 h.p. auxiliary motor built into the apron is used for quick-traverse of the saddle along the bed of the machine.

SOME ENGINEERING PRODUCTS

Some of the products of the British engineering industry are shown on a turntable by the metal-working section and others are to be seen in various parts of the Pavilion. The units exhibited on the turntable include a crankshaft for a Gardner "6 L.W." diesel engine, some large bearings, a railway carriage axle, a sluice valve made by Smith Bros. and Co. (Hyson), Ltd., a typical plastic moulding tool and a Stone variable pitch marine propeller. There is a small axial flow pump made by Mono Pumps, Ltd., and a centrifugal pump made by Gwynnes Pumps, Ltd., which is illustrated on this page.

This pump, which is arranged for a flat belt drive, is of double-entry horizontal split-casing design, with 2½in suction and 2in delivery branches. Its cast iron casing is split on the horizontal centre line with both branches formed in the lower half. The two deep stuffing-boxes are complete with packing-rings and cast iron glands. Lantern rings interspaced with the packing rings are provided with a water-sealing service taken from the pump volute. A double-entry shrouded impeller of cast iron is carried on a high-tensile steel shaft mounted on ball bearings, supported in brackets cast integral with the lower half casing of the pump.

DUPLEX AIR COMPRESSOR

Another exhibit, a duplex air compressor, is of somewhat unorthodox design and is a post-war development of Bristol Pneumatic Tools, Ltd., of Fishponds, Bristol. The illustration of the compressor on this page shows one of the cylinders with a section removed to expose the internal mechanism.

The compressor employs a double-acting

cylinder incorporating a differential piston. The first stage of compression takes place above the piston on the upward stroke, the air being delivered at about 30 lb per square inch pressure to the intercooler. Simultaneously pre-compressed and cooled air at this pressure is drawn from the intercooler into an annular high-pressure cylinder formed between the two differential diameters of the piston. On the downward stroke a fresh charge of air from the atmosphere is drawn into the cylinder above the piston, whilst the air in the annular high-pressure cylinder is compressed to the final delivery pressure.

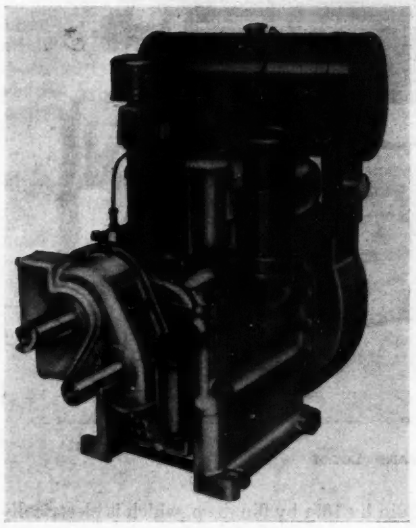
Thus it will be seen that two working strokes are made on each revolution in each cylinder, the arrangement being equivalent to a single-acting compressor having double the number of cylinders.

An important advantage springs from the fact that the annular high-pressure cylinder has a net cooling surface considerably greater than could be secured on an equivalent single-acting high-pressure cylinder, and the design of the air compressor is such that the high-pressure cylinders are in line with the powerful air blast from the intercooler, so that this large high-pressure cylinder area is effectively utilised.

The makers point out that the torque is particularly even in the twin cylinder model exhibited, where the cylinders are at 90 deg. and operate from a single crank throw. This gives four even impulses per revolution, a useful feature in engine-driven and portable outfits where absence of vibration and smooth operation are important.

Another of the exhibits on the turntable is one of the 20 b.h.p. twin-cylinder, air-cooled diesel engines made by Armstrong Siddeley Motors, Ltd., of Coventry. These units, which are of straightforward construction, are designed for working for long periods without attention and for ease of maintenance and overhaul. Instead of the more usual liquid cooling, the various parts of the engine are cooled by a blast of air ducted from a vaned flywheel, and the barrel of the injector is fitted with a ribbed copper cooling sleeve.

The rigid cast iron crankcase has finned cylinders with detachable heads, bolted to it and the skirts of the pistons project down inside the case below the attachment flange. A balanced forged steel crankshaft, carried on steel-backed white metal bearings, has mounted on its front end a spur gear which drives the camshaft and oil pump. An extension from the camshaft protrudes from the crankcase and provides an alternative drive at half engine speed. Push-rods operate the valves through a rocker unit



AIR-COOLED DIESEL ENGINE

mounted on the cylinder head, and the push-rod balls have screw adjustment for tappet clearance setting.

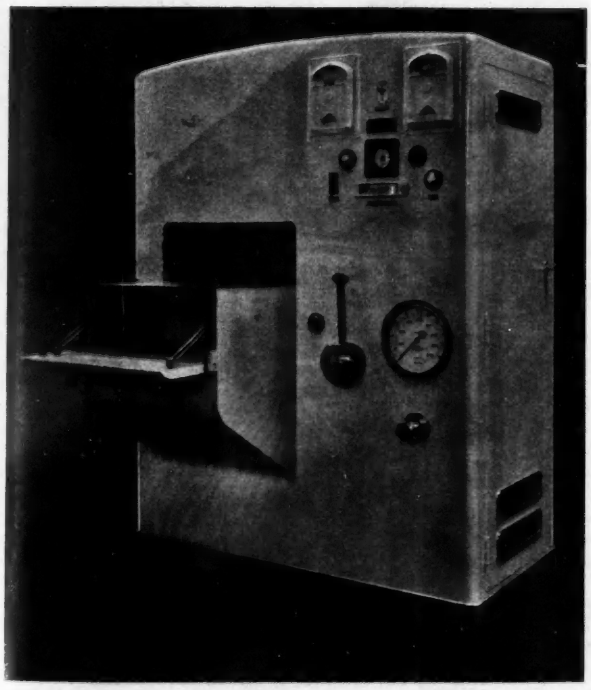
The governor for controlling the fuel pumps consists of two radial grooves formed on the outer face of the camshaft gear wheel, and into each of these grooves is fitted a large steel ball, which makes contact with an adjacent conical disc. The disc is linked to the fuel pump rack rod. As the engine speed increases the balls are thrown outwards and move the disc, which is free to slide on the shaft against the pressure of a calibrated spring. As the speed decreases the disc is returned inwards by the spring. Movements of the disc are transmitted to the fuel pump racks by the link. All main bearings are lubricated under pressure by a gear pump and the cylinder walls and gudgeon pins by splash from the big-end bearings.

The line assembly of units is now generally practised throughout the engineering industry where engines, machines and equipment are produced in large numbers, and a typical small batch assembly line laid down in the Pavilion by A. Reyrolle and Co., Ltd., gives a good impression of the methods used in that company's works. On this line, which was illustrated on Plate 1 in last week's issue of THE ENGINEER, operating mechanisms for the firm's Class C switchgear are assembled by fitters at four stations.

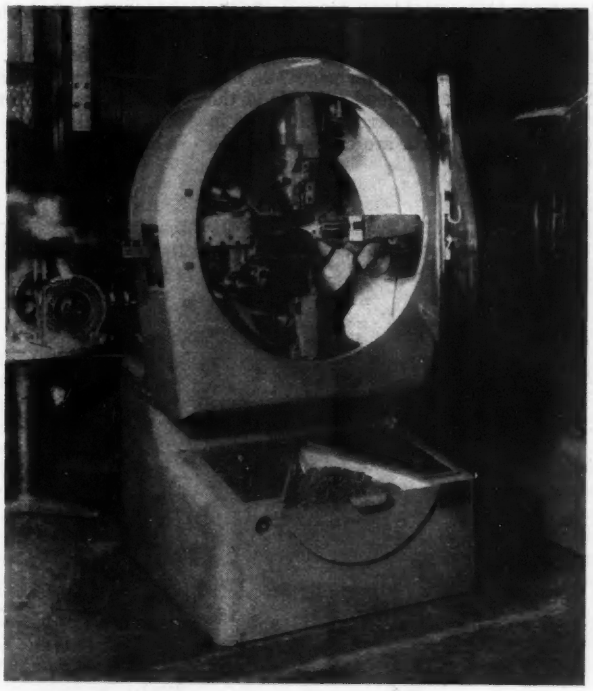
In this system the work is assembled progressively on specially built carriers, which are designed to travel on a tubular track set round the perimeter of the bench. At the first three working stations the units are assembled and at the fourth station the final assembly and testing is carried out with the operating mechanism coupled through its links to a test load housed in a tank below the carrier and its assembly jig. Two spare carriers are provided on the assembly line to maintain an even flow of work round the track.

It will be seen from the illustration in Plate 1 that each assembler has the appropriate trays for tools and component parts within easy reach on the carriers. On the assembly rack other trays contain the detail components and sub-assemblies necessary for one day's production. Individual adjustable lamps at each working station provide adequate illumination for the work.

The illustration shows a quick-make mechanism with spring operation being assembled, and during the course of the exhibition there will also be assembled direct-operated and magnet-operated mechanisms for other types of switchgear. From this exhibit visitors are given a good impression of the way in which time and motion



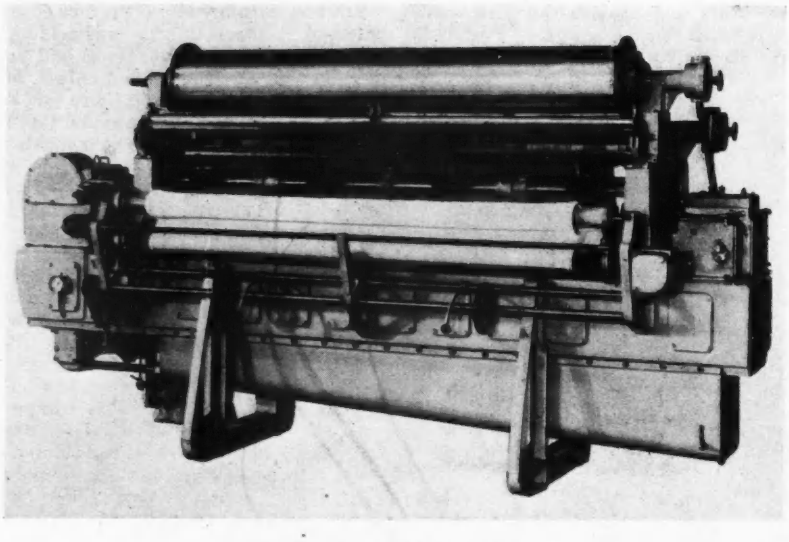
RUBBER MOULDING PRESS



AUTOMATIC FORMING MACHINE

study has been applied to reduce to a minimum the effort required by operators, and the amount of time which can be saved by arranging all work and components conveniently to hand at each stage of assembly.

One side of the ground floor of the Pavilion is divided into sections, in which are arranged demonstrations of various crafts, including instrument making, shoe making, glass blowing, hand papermaking, and wood bending. The next group of exhibits of particular interest to visitors more closely concerned with engineering is arranged in a sunken enclosure in the centre of the main floor. This group of working exhibits is generally entitled "Machine Production" and deals with the equipment and plant used in a number of widely differing industries.



HIGH SPEED WARP LOOM

Machine Production

One of the machines in operation in this section is a self-contained electrically heated hydraulic rubber moulding press, built by David Bridge and Co., Ltd., of Castleton, Rochdale. This machine, which can be seen in one of the illustrations on page 743, is a prototype unit. It is a good example of the clean lines, grouped controls, and way in which all moving parts are enclosed, in the latest types of plant used in the plastics and rubber industries. This machine has 24in square platens, which can be heated electrically up to a temperature of 150 deg. Cent. and loaded to a total of 130 tons or 500 lb per square inch. Beneath the mould loading table of the machine is a core oven, 20in by 16in by 9in deep, which is electrically heated and can be used for storing cores and for mould inserts.

Once the platens have been heated to the desired temperature, and the moulds have been placed on the loading table and charged with rubber cores, &c., the gate is moved across and the mould pushed into the press. When the gate has been closed a signal light indicates when it is fully home and the pump motor is automatically started. The press is then closed on the mould by movement of the control lever and the timing device is energised by a switch to start the automatic curing cycle, the completion of which is indicated by a second signal lamp.

The automatic forming machine of Heenan and Froude, Ltd., of Worcester, which is shown in operation, demonstrates in an impressive way the speed at which small metal components can now be produced and how attractive clean lines can be introduced without impairing the efficiency of a machine when totally enclosing the mechanism for protective purposes.

This machine is driven by a self-contained 1½ b.h.p. motor through vee belts and stepped pulleys, giving three speeds, corresponding with an output of 100, 150 and 200 parts a minute.

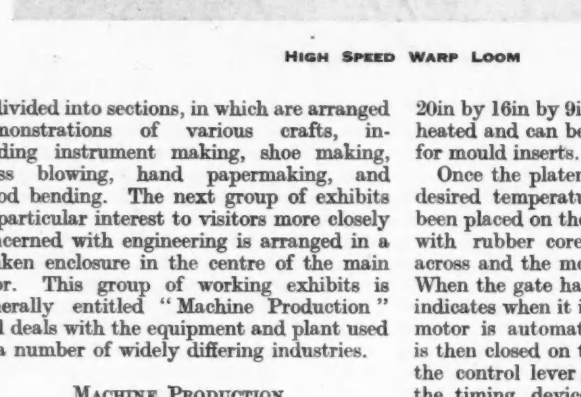
This machine, the makers' "M.I.4" universal model, is designed to produce a wide variety of forms direct from coiled wire or strip metal, according to the forming tools employed. Its forming slides are arranged radially round a circular vertical face and the angular position of these slides, with the exception of the first, can be altered when necessary.

Each slide is made integral with its driving gear so that the whole assembly can be moved as a unit from one angular position to another. The driving gear of all movable slides consists of a rotating crank disc, driven from a single central gear-wheel and arranged to reciprocate the slide through toggle levers, which impart a heavy pressure upon the form being produced.

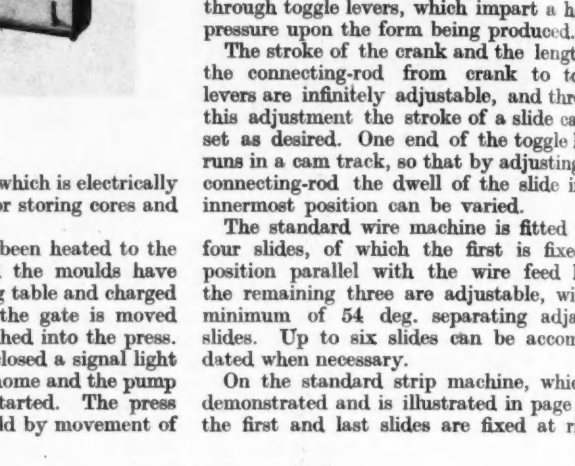
The stroke of the crank and the length of the connecting-rod from crank to toggle levers are infinitely adjustable, and through this adjustment the stroke of a slide can be set as desired. One end of the toggle lever runs in a cam track, so that by adjusting the connecting-rod the dwell of the slide in its innermost position can be varied.

The standard wire machine is fitted with four slides, of which the first is fixed in position parallel with the wire feed line; the remaining three are adjustable, with a minimum of 54 deg. separating adjacent slides. Up to six slides can be accommodated when necessary.

On the standard strip machine, which is demonstrated and is illustrated in page 743, the first and last slides are fixed at right-



AUTOMATIC POLISHING MACHINE



CARPET LOOM

angles to each other. The remaining two slides are adjustable to within 54 deg. of the adjacent slides. Here also a total of six slides can be fitted. Any increase over the standard number of four slides involves a reduction in the amount of angular adjustment available.

Finished components can be positively stripped off the central mandrel by a direct-acting cam-operated stripper plate, or by reversal of the stripper operating cam, so as to cause retraction of the mandrel.

All the mechanism, as can be seen in the illustration, is contained in the main head of the machine. Although nominally vertical, to give easy access and facilitate the setting-up of tools, this head is hinged and when ready for work it is inclined forward by operating a handle. This inclined setting permits completed products to drop into a container formed in the base of the machine.

A die-casting machine shown by the E.M.B. Company, Ltd., is designed to produce components up to 12 oz in weight when fitted with a 1¼in plunger and, depending upon the class of work, can make up to twenty shots per minute. The machine has a gas-heated melting-pot in which up to 200 lb of metal can be melted per hour to keep pace with the high output of which it is capable. A single operating lever controls the speed of opening and closing of the dies through the hydraulic system. This lever also controls the metal injection and is so interlocked that injection can only take place when the dies are closed and locked. An interlocked safety guard is fitted and the dies cannot be closed or metal injected until this guard is in the working position.

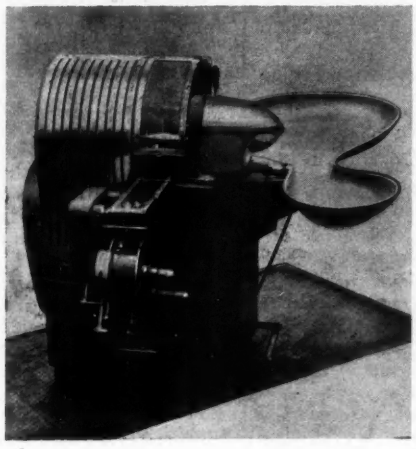
Very high standards of finish are now called for on plant and equipment of all kinds, industrial, transport, domestic, &c., not only for sales promotion but also to improve working conditions and combat corrosion. These standards have done much to improve modern living and working conditions, and to make them possible a wide range of plant and materials has been developed by specialist firms. One such firm, which has concentrated largely on equipment and materials for plating and polishing, is W. Canning and Co., Ltd., of Great Hampton Street, Birmingham, 18. Typical of the polishing machines made by this company is a rotary automatic machine shown in the exhibition and illustrated opposite.

The machine is not a standard unit but is made with four different types of heads to show the range available for various purposes. It is an automatic indexing table machine, and could be used for mass production polishing of circular components. It comprises a 30in diameter table fitted with six chuck spindles and driven from a motor enclosed in the base. The various types of heads arranged round the machine are selected according to the particular article to be polished, and these heads can be adjusted on their pedestals to suit the angle and shape of the job.

On the front of the machine is a push-button station, having separate buttons for each motor and an emergency push button for stopping all motors in case of emergency. The chucks for holding the articles during the polishing operation automatically lock the article on the chuck whilst polishing and release it to be removed when the chuck is indexed to the loading and unloading positions. These machines are manufactured in sizes from 20in diameter to 8ft diameter and can be arranged for either continuous operation or indexing as required.

The number of articles which can be polished per hour vary between 100 and 1200 according to the type and size. With these machines a uniform finish is obtained on the articles when employing unskilled operators.

In addition to the machines more directly concerned with engineering, some interesting textile and associated plant is to be seen in operation. One of these machines is the "P.S.C." worsted spinning frame (Bradford System) of Prince-Smith and Stells, Ltd., Keighley. The makers of this machine point out that if the centrifugal spinning of dry yarn were to be attempted as is common practice with wet yarn, the mass of material formed within the container would collapse into an unusable tangle of waste and could not be removed in its formed shape. With the introduction of the "P.S.C." centrifugal machine it is possible to transfer



SWEET WRAPPING MACHINE

the dry spun yarn from the container to a bobbin in a serviceable package to be used in subsequent processes.

Another textile machine is the 84in high-speed warp loom made by F.N.F., Ltd., of Burton-on-Trent, illustrated on page 744. It is designed to produce at high speed a wide range of quality fabrics in rayon, nylon and cotton and its standard production speed is 1000 courses, or loops, per minute—equivalent to some 25 yards of fabric an hour. The machine is a 28 gauge unit—that is to say that it has twenty-eight needles to the inch; its 2352 needles are assembled in quickly and easily replaceable groups across the full width of the needle bar. In these machines all cams other than pattern-wheels have been dispensed with and it has balanced, double-eccentric mechanism, which reduces noise and vibration to a minimum. The conventional bearded needle is replaced on these machines by a needle of the firm's own design. This form of needle is hollow and the tongue is carried on a shank, which reciprocates in the needle bore.

One of the most spectacular machines at work in this section is an Axminster carpet loom, made by Platt Bros. and Co., Ltd., of Oldham, and illustrated on page 744. Machines of this design are made by the company for producing seven different carpet widths from 18in to 54in. They produce at a very high speed a tufted carpet similar in construction and appearance to the Oriental carpet made on hand looms. The makers point out that in carpets produced on these machines none of the expensive tufted material used to produce the pattern is hidden away or wasted except for the small amount required to obtain satisfactory binding. An unlimited number of colour combinations can be woven into the pile and a loom will run for about one and a half days without need for cord replenishment, as the large diameter chain warp beam contains some 1700 yards of yarn.

Any carpet weaving process demands from the operative high technical skill, and as speeds are raised it becomes increasingly difficult, without undue fatigue, to give full attention to all details. To overcome this difficulty there are incorporated in the loom a series of electrical stop motions, any one of which will immediately stop it should there be any mechanical failure, breakage of warp, weft or selvedge yarn, or other accidental cause. These electrical stops make it possible for one weaver to attend two or more looms in the sure knowledge that a machine will stop automatically if attention is required.

Only a small proportion of the general public appreciates the considerable influence that the engineer has had on the food processing and preparing industry, and the extent to which food prepared under ideal conditions of cleanliness depends upon engineering design and materials and modern production methods. Two or three working exhibits in the pavilion give a small insight into this little-known, but very important, branch of engineering.

One of these exhibits is a standard gas-fired wafer oven, made by T. and T. Vicars, Ltd., of Newton-le-Willows. This machine has eighteen pairs of plates or moulds, each of which is used for making thirty standard wafers at a time. In the sequence of operations the plates are filled with a metered supply of batter at one end of the machine, closed, and conveyed through a baking zone to the opposite end of the machine, where they open automatically for the sheet of wafers to be removed.

The plates, of machined and ground cast iron, are chromium-plated and designed to prevent distortion from repeated heating and cooling. They are secured by a three-point suspension system to malleable iron carriers connected together by links to form an endless chain through the baking chamber of the machine. Along the full length of the baking chamber are triple burner rails, fitted with standard pressure gas burners or porcelain rosettes arranged to burn town's gas under normal pressure mixed with compressed air up to 5 lb per square inch.

The machine is driven through a variable-speed transmission gear giving an infinitely variable range of baking times from one to three minutes. When using a baking time of two minutes and producing wafers averaging 480 to the pound, the machine will produce about 360 lb of wafers in an eight-hour working shift.

Also shown in operation is the confectionery wrapping machine, made by Rose Bros. (Gainsborough), Ltd., illustrated above. This machine has an output of 120 to 160 wrapped sweets per minute and the sole duty of its operator is to push the sweets forward from the large tray in front of the machine into the indents of a circular rotating feed plate. The sweets are carried one at a time to a twisting head, where a strip of paper cut from a continuous feed band is gripped in the heads and twisted round the sweets. As the wrapped sweets are released from the twisting head they are deposited into a chute leading out of the side of the machine.

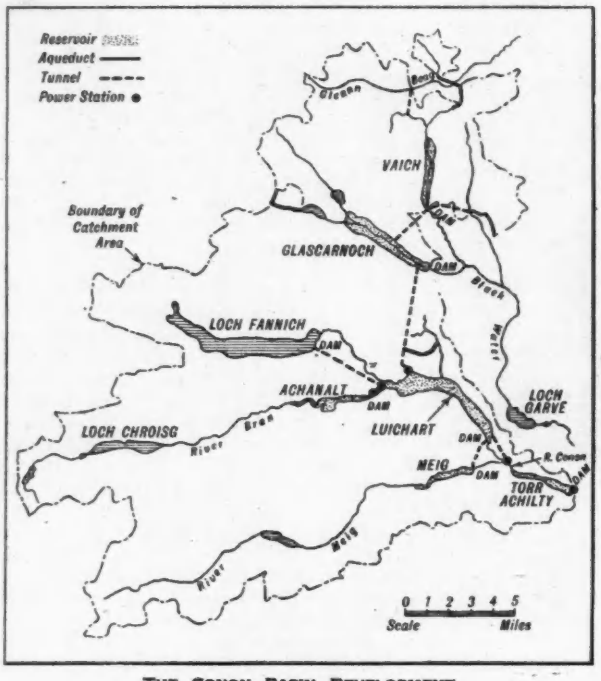
In the demonstration which has been arranged with this machine the wrapped sweets fall from the chute on to a "Mota-veyor" supplied by J. Collis and Sons, Ltd. This conveyor deposits the sweets on to an adjoining weighing and packing bench, where they are bottled ready for dispatch.

(To be continued)

North of Scotland Hydro-Electric Schemes

No. III—THE FANNICH PROJECT—PART I*

THE North of Scotland Hydro-Electric Board's proposals for the development of the River Conon basin in Ross and Cromarty provide an interesting example of the comprehensive development for power production of an entire river catchment. The various projects of the Conon basin are themselves small or moderate in size, but the total power production of them all will be considerable when they are all completed. It is estimated that about 442 million kWh will be produced annually from the six power stations of this group of schemes, which will have a total installed capacity of about 107MW. At the present time the first stage of the developments in the Conon basin, the Loch Fannich scheme, has been completed, apart from some aqueducts, and it is proposed to describe this scheme in some detail in this article. First, however, we have included an outline of the proposals for the Conon basin.



THE CONON BASIN DEVELOPMENT

THE CONON BASIN DEVELOPMENT

The catchment area of the Conon basin is about 350 square miles in extent and includes a number of tributaries and lochs, which are shown on the accompanying map and diagram. The average rainfall in this area is about 75in.

Loch Fannich, which is supplied by a catchment of about 55 square miles, is an unusual loch on account of its depth near the shore (it is about 6½ miles long with an area of about 3½ square miles) and on account of its high elevation, the normal water level being about 822ft A.O.D. These factors were, of course, favourable from the hydro-electric point of view, and the loch was selected as one of the major storage reservoirs of the group, and was utilised for the first stage of development. A tunnel about 19,500ft long has been driven from the south-eastern shore of the loch and connects with a pipe-line leading down the hillside to the Grudie bridge power station, which is situated at the confluence of the rivers Grudie and Bran. This power station has an installed capacity of 24MW, at present under a gross head of 529ft.

At a later stage a dam about 20ft in height and 1200ft long will be built across the eastern end of the loch, and an aqueduct is being constructed nearby to divert the flow of the two major tributaries of the River Grudie into the loch. The flow into the reservoir will also be increased slightly by the construction of aqueducts on the high ground south of the loch. The course of the River Grudie from the loch to the River Bran is undeveloped, so that it will not be necessary to allow a flow of compensation water from the loch into this length.

North of Loch Fannich there will be a project centred on a storage reservoir on the Glascarnoch River, a tributary of the Black Water. The flow of Strath Rannoch will be diverted at a high level to Strath Vaich, where a dam 70ft high will be constructed. The reservoir formed by this dam will be connected by a tunnel to the Glascarnoch reservoir, which will be at substantially the same level as the reservoir in Strath Vaich. The Glascarnoch reservoir will be formed by a dam 90ft high, and a tunnel will lead from it to a power station of 24MW installed capacity at the head of Loch Luichart. The natural catchments of the three tributaries supplying the power station will be increased by the construction of various aqueducts.

On the River Bran a barrage will be built at Achanalt with an aqueduct leading to a low-head power station situated just upstream of the existing Grudie bridge power station, with an installed capacity of 2MW.

The level of Loch Luichart will be raised by a dam at its eastern end, and a tunnel will lead from the loch to a generating station of 24MW installed capacity on the banks of the River Conon, near its junction with the River Meig. A dam will be built across the Meig to form a new reservoir roughly at the same level as Loch Luichart, to which it will be connected by a balancing tunnel.

Downstream of Loch Luichart there will be yet another development with a dam and power station across the River Conon at Torr Achilty. This station will absorb the discharges from the Loch Luichart station and will itself have an installed capacity of 15MW. The dam will be 45ft high. There is an existing power station at Conon Falls, which supplied electricity to Strathpeffer and Dingwall before the grid was built and which will eventually be superseded. It has an installed capacity of 2·75MW, with an annual production of some 14 million units, the head being 121 ft.

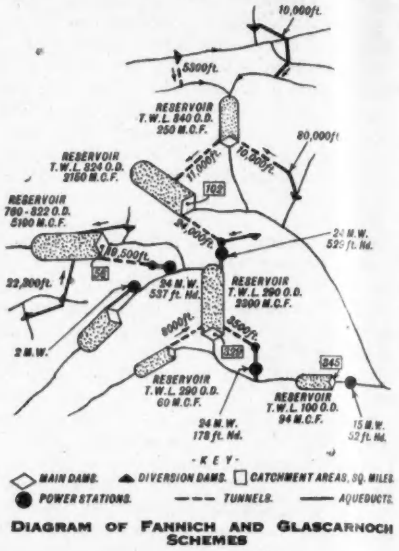
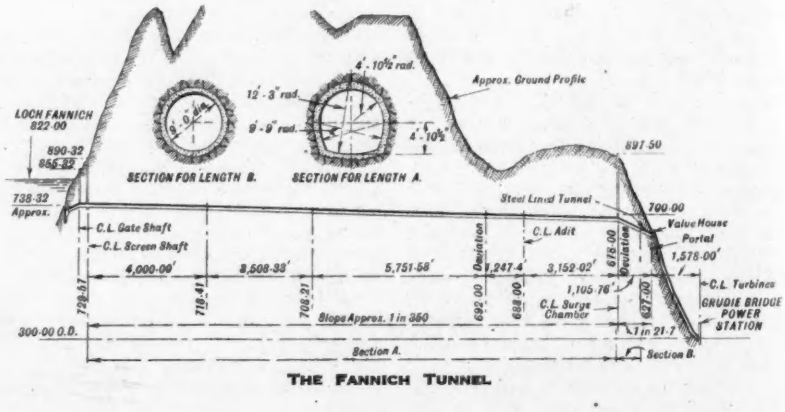


DIAGRAM OF FANNICH AND GLASCARNOCH SCHEMES

THE FANNICH SCHEME

Turning now to the Fannich scheme itself, the scheme as so far constructed is very

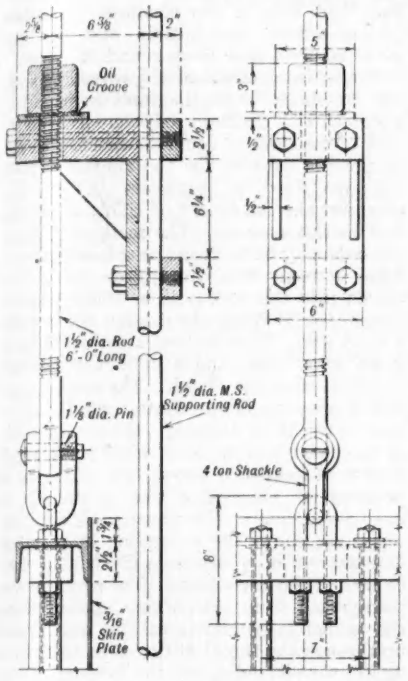


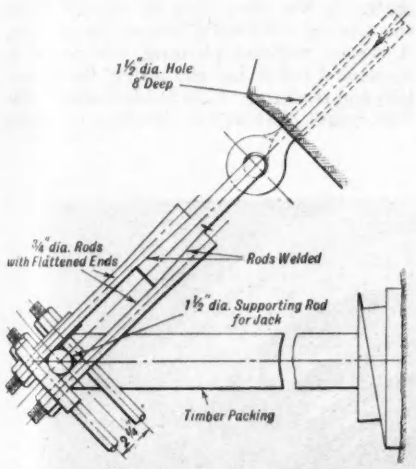
THE FANNICH TUNNEL

* No. I, "An Introductory Survey," appeared on July 14, 1950, page 28. No. II, "The Loch Sloy Project," appeared July 21, 28 and August 4, 1950, pages 57, 87 and 115.

simple in its lay-out, consisting of a tunnel from the loch, followed by a single pipe-line about 1550ft long leading to the power station, in which two 12MW machines are installed. The work has also included a road diversion and the construction of a bridge at the power station site, and the preliminary works involved building access roads to the loch, for work at the upstream end of the tunnel, and to the tunnel adit. The tunnel inlet allows a draw down of 60ft in Loch Fannich, the storage thus available being equivalent to about 60 per cent of the annual output of 79 million units.

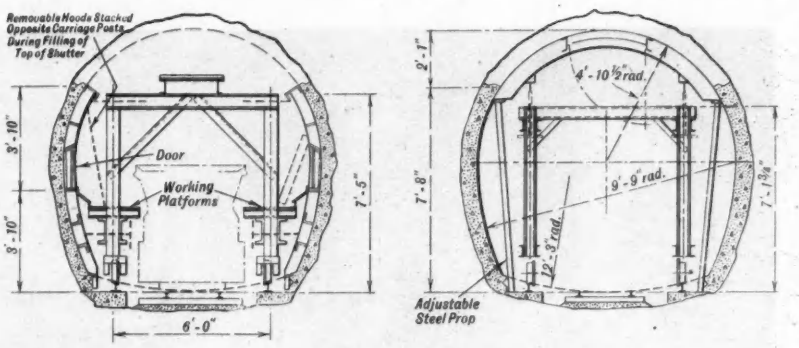
The tunnel is of horseshoe section of 10ft equivalent diameter, and will take a flow of





ARRANGEMENT AT SCREW JACK AND METHOD OF SECURING VERTICAL RODS

760 cusecs. It was driven through typical Highland formations of mica schists and quartzose-schists, the latter predominating; veins of quartz were also present and the rock was uniformly hard and tough throughout the length of the work. The tunnel was driven from three main faces—two from an adit and one from a working shaft, which is now the screen shaft. Work from the gate shaft to the loch penetration was kept as a separate operation, so as not to interfere with the main tunnel construction and for reasons of safety. The accompanying illustration shows a longitudinal section of the tunnel. The line of the tunnel, due to change of direction, varied greatly to the strike of the rock, but no steel arch supports were required, except for the underwater connection, which is described in a later section of this article. Drilling was carried out from a jumbo mounting five drifters, and mucking was done



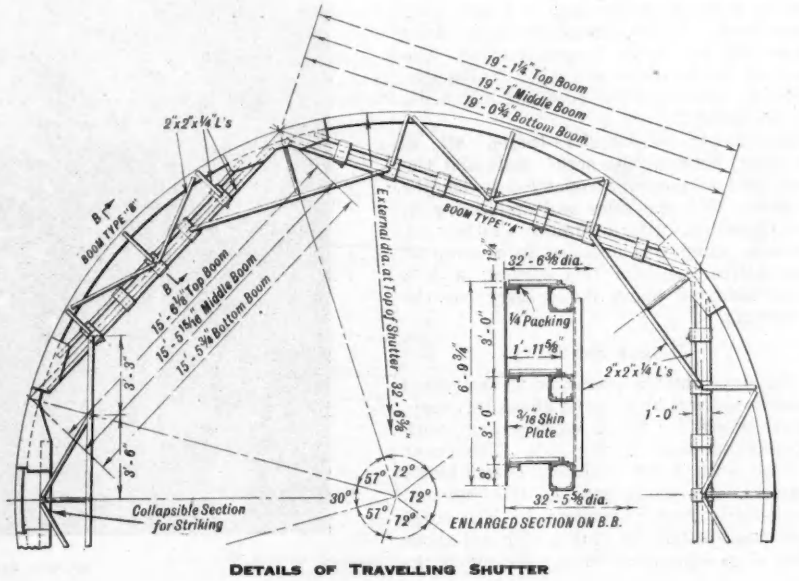
TUNNEL SHUTTERING

with Eimco 21 loaders, loading 2 cubic yard skips, which were pulled along the 2ft gauge track by electric locomotives. Progress was at the rate of about 90ft a week from each face, working on a three-shift basis, with about fifteen men in each shift. The maximum progress recorded on one face was 140ft a week.

The jumbo travelled on 2ft gauge track on two bogies and was made up of tubular framework, which also acted as an air receiver and distributor. It was fitted with side platforms, which were folded down for travelling and propped up when in use. The drifters used for the main work were Ingersoll D.A. 35 machines, three being used at the top of the work and two below. Generally the "burn cut" method was adopted with about six holes, of which three were left uncharged, there being an average of thirty holes altogether. The pull was generally about 7ft, but up to about 11ft was obtained in one or two instances. The explosive used was generally polar ammon gelignite.

A plain concrete lining was used for the great majority of the tunnel, a steel reinforced lining being used only for the length downstream of the surge shaft. Concreting was carried out in four stages. First, two haunches were cast, one along each side of the tunnel, on which the rails to carry the steel shuttering were set; these rails were positioned to line and level and acted as a datum for the rest of the work. In the second stage the side walls were concreted, and in the third the tunnel soffit; finally, the invert concrete was placed. The extent of the various stages may be observed from the accompanying diagrams, which show the shutters used for concreting the second and third stages on the left and right of the illustration respectively.

It was originally intended, if sufficient speed was achieved in driving, to concrete the lining after the driving was finished, but the shutters were designed to keep the central 2ft gauge track open for the trains of muck skips during the concreting operation, and this requirement was one of the main considerations in their design. As it turned out, high driving speeds could not be obtained. The restricted space in the tunnel made it necessary to work to close clearances, as may be observed from the first of the diagrams, on which the outline of a locomotive and skip is shown dotted. The shuttering for the second stage of concreting was positioned by screw jacks, and the concrete was placed by hand from a working platform into the doors which are shown about halfway up the shutter. The concrete was brought in ½ cubic yard trays, which were mounted on carriages so that when the concrete train stopped in position there was a



DETAILS OF TRAVELLING SHUTTER

tray of concrete opposite each door. The sides of the trays were then lowered down; the bottom of each tray was about level with the working platform, so that its sides rested horizontally on the platform when lowered, thus providing a convenient arrangement for shovelling the concrete into the shutter. When the shutter was filled up to the intermediate level the doors were closed and the rest of the concrete was put in from the top.

JACKING UP SURGE SHAFT SHUTTERING

Immersion vibrators were used to consolidate the concrete.

The soffit shutter was filled by hand progressively from one end from a series of doors. The concreting trays were mounted higher for this operation and with their long axis perpendicular to the line of the tunnel, to give the best working arrangement. The second diagram shows the carriage for moving the shutter and the props, each provided with a screw jack at its foot, which took the load during the concreting. The dotted line in the diagrams which shows the position of the invert lining may also be noted, together with the projection left at the bottom of the second stage concrete to facilitate screeding the invert. The shutters used for the second and third stage of concreting were generally 70ft and 40ft long respectively, being assembled from units about 20ft long to the length required. The concrete was mixed at a 1 cubic yard weigh-batching plant near the adit, the mix being approximately $3\frac{1}{2} : 2 : 1$.

The length of circular tunnel, 9ft in diameter, between the surge shaft and the steel-lined section was concreted in lengths of about 20ft, the sides and arch being in one operation, with a timber shutter. A concrete pump was installed in a sump at the upstream end of this section, with a mixer mounted above it, to carry out the concreting.

Surge Shaft

The surge shaft is connected to the tunnel directly below it by a throat about 13ft deep, which is 12ft by 6ft in cross section, with 6ft diameter semi-circular ends. The throat is lined with a 2ft thickness of reinforced concrete, the whole area of this junction being fairly heavily reinforced. The surge shaft itself is 32ft 6in in diameter and about 200ft deep, extending to the surface of the hillside above the tunnel. To construct the surge shaft a stope was first driven vertically upwards from the tunnel. The stope was rectangular in cross section, about 12ft by 6ft in size, and was timbered at one end of its cross section and partitioned off into two parts, the smaller of which was just large enough for access. The larger compartment was fitted with a hopper door at the level of the tunnel roof, and the spoil from the work above was loaded into skips in the tunnel by operating this door. The spoil was kept stacked up in the stope, high enough to allow the tunnellers to stand on it to work at the face. After drilling and charging the holes the tunnellers retired down the access compartment, closing a protective door at the top of it to allow the blasting of the next pull. With the spoil at a convenient height the process could then be repeated until the stope was completed.

The enlargement to the full section of the surge shaft was then carried out working downwards, the spoil being deposited down the stope. Owing to their lightness, tungsten carbide drilling tools were used for this work. There was no access road to the surge shaft, and the tools were brought up the hillside on pack ponies. The heavy equipment needed—shuttering and a derrick—was dragged up by tractor.

An interesting design of travelling shuttering was used to concrete the greater part of the surge shaft. A plain concrete lining, with a minimum clearance of 1ft 6in over rock points (average thickness about 2ft 6in) was constructed for a height of 155ft from the bottom of the shaft. Above this lining hollow precast concrete slabs were used, and the hollow spaces were reinforced and filled with in situ concrete. The slabs project above the hillside and are surmounted by a deer fence round the shaft.

The main elements of the travelling shutters are shown in the diagrams on page 747. Fourteen $1\frac{1}{4}$in diameter rods were fixed to the rock of the shaft at equal diametral intervals to provide support for the shutter. Each rod was fixed at intervals of 5ft and extended the full height of 155ft, which was cast in this manner. The method of fixing the rods may be seen in the second diagram. Two dowels, with fish-tailed ends, were driven into the rock with a wedge inserted under each to divide the fish tail and provide a good grip. The rod was attached to each dowel by a collar and a strut was inserted, as indicated in the sketch. The construction and dimensions of the shutter itself may be seen in the third diagram; the arrangement of the collar and 6ft long screw jacks which were used to lift it is also shown. The rate of progress of concreting was about 8ft in twenty-four hours. The photograph which we reproduce shows the concreting in progress. One-quarter of a turn was given at a time to each of the screw jacks. The concrete was transported from the mixing station along the tunnel in special skips and was hauled up through the throat of the surge shaft by a small crane standing at the bottom of the shaft. It was then lifted by the derrick at the top and discharged behind the shutters. A second working platform was provided, suspended below the shuttering, for inspection and rendering of the finished work. The total height of 155ft was concreted in twenty

SOFFIT SHUTTERING IN TUNNEL

days, good progress being made after the first week, during which the weather was bad.

Screen and Gate Shafts

Two shafts were sunk at the upstream end of the tunnel. As already mentioned, the screen shaft was used as a working shaft for the main tunnel drive. A concrete pump was employed for placing the concrete lining in the last drive to the loch connection and in that part of the tunnel adjacent to the two shafts. An interesting point arose here, for it is not usual to use a concrete pump on a downward gradient, and care was needed to ensure successful use of the pump, always keeping the pump line full and providing air outlets on the vertical pipe down the shaft.

About 90,000 cubic yards of excavation was carried out to complete the tunnelling of the Fannich scheme, and the quantity of concrete placed in the tunnel lining was about 40,000 cubic yards.

(To be continued)

Resignalling at York

No. I

YORK has been called the "Grand Junction for the North." A glance at the railway map alone is enough to indicate something of the pressure to be expected at times, but when coming to examine the channels through which traffic regularly flows, the need for close regulation of all train movements, and for constant co-ordination of the work at the various junctions appears essential if congestion is to be avoided. The concentration of signalling control in one relay interlocking is a logical step from the traffic point of view, but the engineering work involved renders York, both in the number of signalling functions included and in its geographical extent, by far the largest single interlocking to be found anywhere in the world. The contract for the work was placed by the London and North-Eastern Railway and work was begun in 1938; due to the war, however, installation had to be suspended, and it was not until May, 1951, that the complete scheme was put into service.

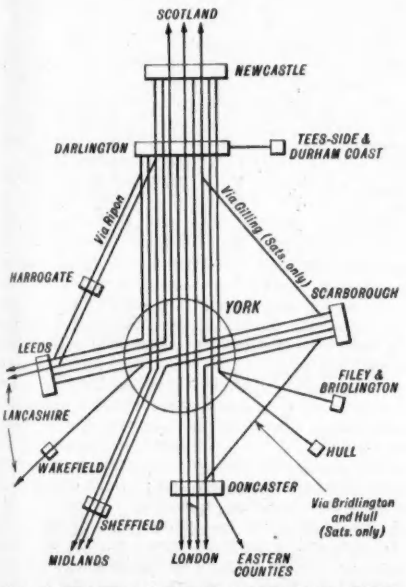


FIG. 1—TRAFFIC "FLOWS" THROUGH YORK STATION

The diagram Fig. 1 indicates the regular channels of traffic through York, though not the volume of such traffic. Three lines on the diagram leading to the Midlands, for example, signify the "channels" (*a*) from Tees-side and the Durham coast, via Darlington, (*b*) from Newcastle, (*c*) from Scarborough. Traffic in certain of these channels is liable to become very heavy at holiday periods, notably in those from Leeds, Lancashire and the Midlands to Scarborough; and this traffic crosses on the level the streams from Newcastle and Scotland to London. Until the completion of the present scheme of resignalling manual block working had been in operation on all lines except the main route to the North, and this latter has been equipped with four indication day colour light signals since 1939 over the 42¼ miles between Skelton Junction, 1¼ miles north of York itself, to Darlington. In the approaches and immediate neighbourhood of York Station traffic was formerly controlled from ten signal-boxes, having between them no fewer than 970 levers, and their positions are shown on the accompanying sketch map, Fig. 3. Of these ten mechanical boxes only three now remain. Skelton, with seventy-five levers, has been remodelled by the inclusion of such electrical equipment as is necessary to conform with the general scheme of colour-light signalling on the main line between York and Darlington, while the remaining two, Burton Lane and Bootham Junction, lie at the entrance to the colour-light area, on the approach lines from Hull and Scarborough. The work previously done by 841 mechanical levers is now concentrated in the new control panel. The new work covers a total of 33¼ track miles, and the station lay-out is shown in Fig. 4. With the completion of the York scheme the East Coast route from London to Scotland is now colour-light signalled over a stretch of 48¼ miles, from Naburn to Darlington. The York scheme extends also southwards on the Leeds and Normanton lines to Copmanthorpe, 4 miles south of York.

It will now be appreciated that a remarkable measure of signalling co-ordination is achieved by bringing the approach lines from the South, with their varied and heavy traffic, under direct control of the same box that is responsible for the station and for the complexities of working resulting from the crossing of main line and Scarborough trains at the north end. While such co-ordination may be attractive in theory, the practical working out of such a scheme might well give rise to great difficulties, and it is in this respect that the York scheme is of such exceptional interest In recent years there has been a growing tendency to relieve signalmen of much physical work and routine duties. The use of control panels, with relay interlocking and route switching, has not only reduced the actual labour involved, but has reduced the number of lever movements to be made, and by this means signalmen have been able to devote more attention to the primary task of traffic regulation; operation has improved because it has been found possible for larger areas to be placed under the control of one man. Northallerton is a particularly good example of this tendency, where, as described in The Engineer for June 3, 1949, a relay interlocking operated by one signalman controls an important main line junction and its approach lines from five directions. This same principle has now been applied at York on a

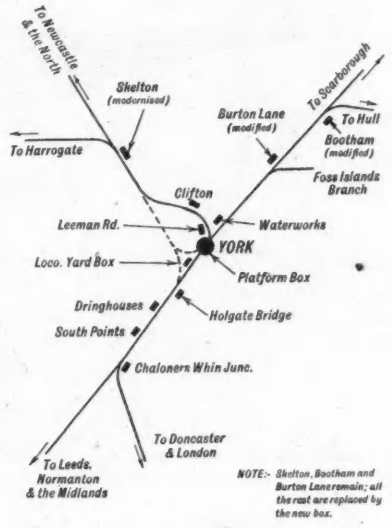


FIG. 3—SKETCH MAP SHOWING POSITIONS OF SIGNAL BOXES NOW REPLACED

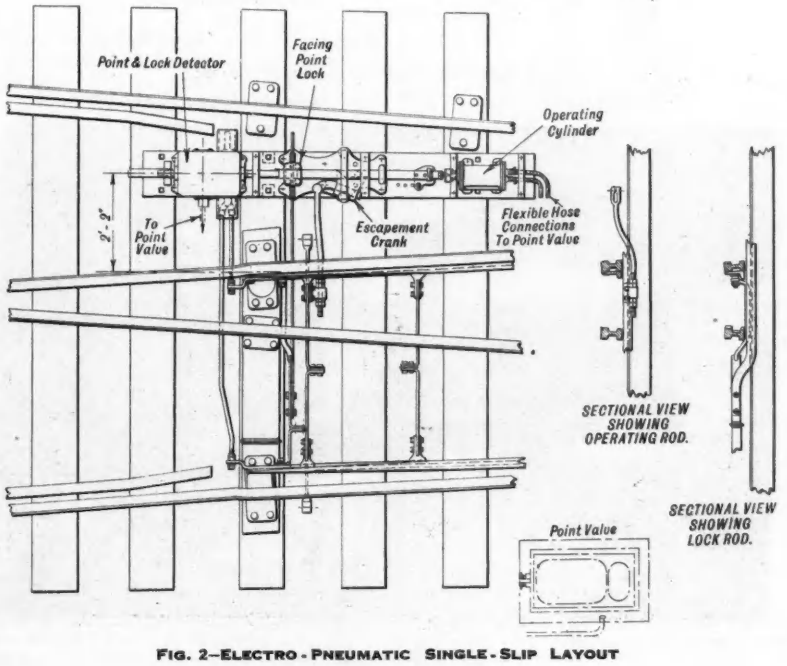


FIG. 2—ELECTRO-PNEUMATIC SINGLE-SLIP LAYOUT

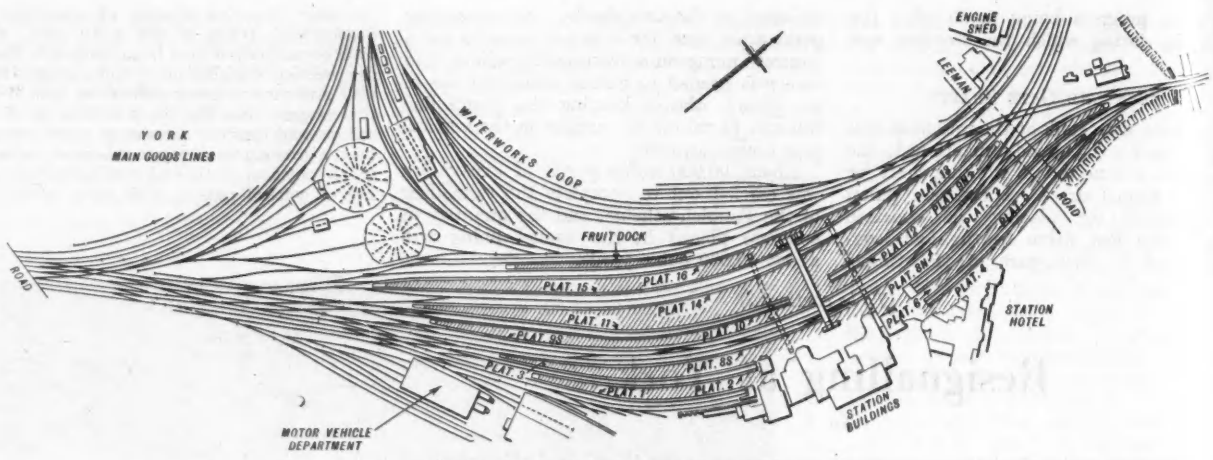


FIG. 4—YORK STATION TRACK LAYOUT

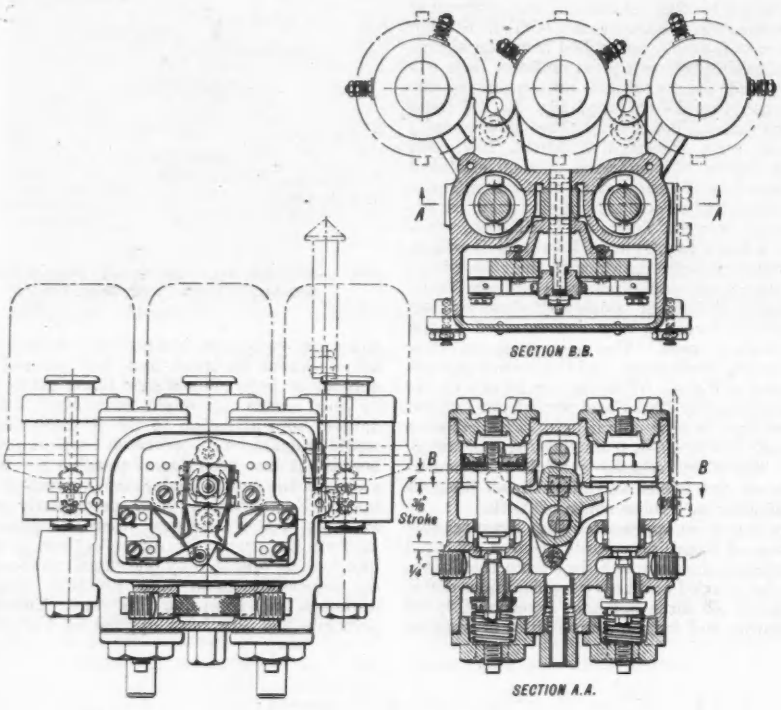


FIG. 5—ELECTRO-PNEUMATIC POINT VALVE

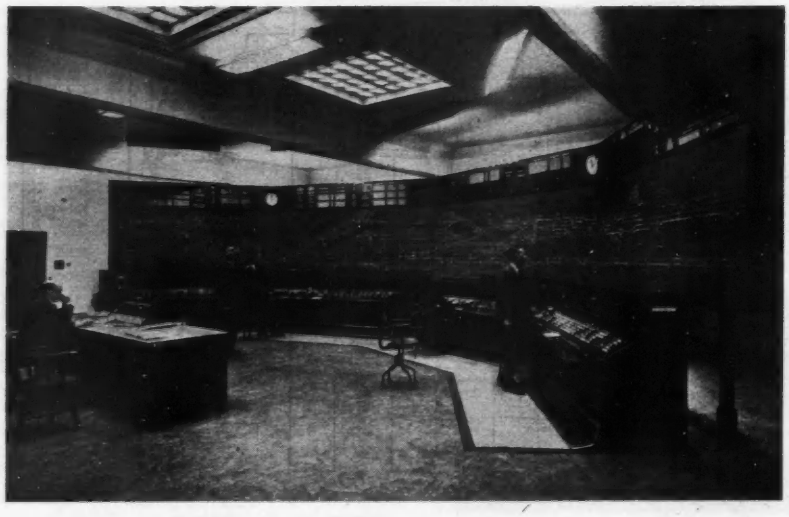


FIG. 6—CONTROL ROOM

much larger scale, where a control panel of roughly four times the physical size of the Northallerton panel is used to handle the work formerly done by 841 mechanical levers. The new control panel requires the services of only four signalmen, working under the general direction of a traffic regulator stationed in the box. When the project was first under consideration by the London and North-Eastern Railway the alternative of using an all-electric power interlocking frame was carefully examined. It was estimated, however, that a frame of no fewer than 1070 levers would be needed, and, on the dual score of compactness and the far fewer men needed for operation, the control panel was chosen.

Before coming to describe the work in detail a further point of major principle must be emphasised; this was the decision to use the electro-pneumatic system of point operation. The former North-Eastern Railway installed several plants designed by the McKenzie, Holland and Westinghouse Power Signal Company, notably at Tyne Dock in 1902, at Hull in 1905, and at Newcastle in 1907. The latter is still in service, and the Hull plant was modernised and converted to a route-relay interlocking in 1938. While making a trial of all-electric point operation in a modern concentrated power interlocking at Darlington, the London and North-Eastern Railway decided to revert to the electro-pneumatic system for York, where speed of point operation is very necessary in the expeditious handling of train movements over conflicting routes. Electro-pneumatic operation has, however, not been carried to the furthest extent of the new York interlocking. But speed of point operation is not the main consideration; long experience with the electro-pneumatic system has shown that it is less prone to failures. At the outlying junctions, however, the reduced number of point movements to be made did not justify the extension of the air main, with consequent increase in compressor capacity. On the main line northwards towards Skelton, and on the Scarborough line, electro-pneumatic operation is carried to the limit of the interlocking, but south of the station the air main is not carried beyond the northern connections to the Dringhouses down sidings.

THE NEW SIGNALLING SCHEME

Except in a few instances four indication colour-light signals are now installed on all running lines. A number of these signals are automatic, including the first encountered in the colour-light area when approaching from the south. In accordance with standard practice, direction indicators are used at all diverging points approached at speed, while in the immediate approaches to the station illuminated route indicators of the multiple lamp or "theatre sign" type are used. There are seventy-nine main running signal locations, and the complicated nature of the lay-out is further emphasised by there being no less than fifty-three route and direction indicators. The subsidiary signals, both for shunt and calling-on

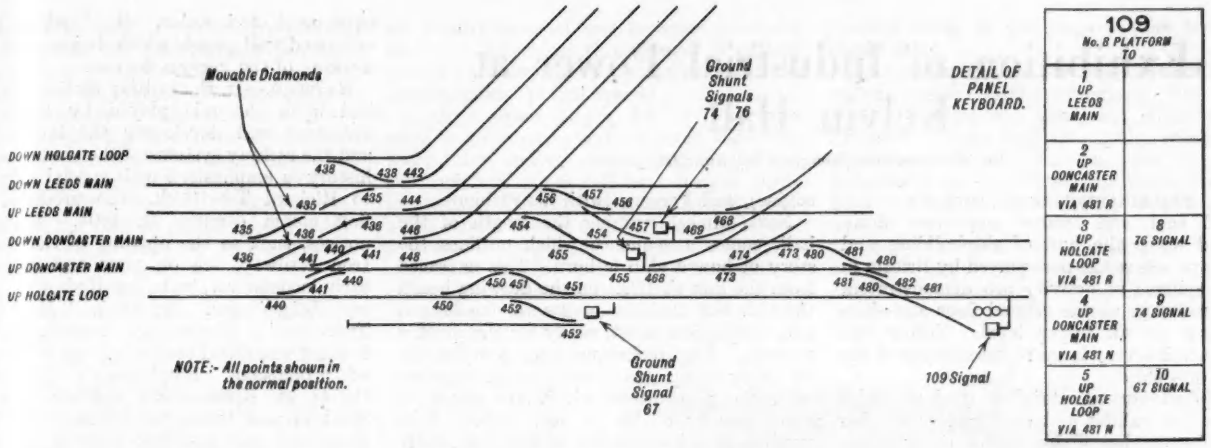

Movable Diamonds
Ground Shunt Signals 74 76
DETAIL OF PANEL KEYBOARD.
DOWN HOLGATE LOOP
DOWN LEEDS MAIN
UP LEEDS MAIN
DOWN DONCASTER MAIN
UP DONCASTER MAIN
UP HOLGATE LOOP
NOTE:- All points shown in the normal position.
Ground Shunt Signal 67
109 Signal
109
No. 8 PLATFORM TO
1 UP LEEDS MAIN
2 UP DONCASTER MAIN VIA 481 R
3 UP HOLGATE LOOP VIA 481 R
8 76 SIGNAL
4 UP DONCASTER MAIN VIA 481 N
9 74 SIGNAL
5 UP HOLGATE LOOP VIA 481 N
10 67 SIGNAL

FIG. 7—ROUTES FROM SIGNAL 109

purposes, are of the position light type, 215 in all. An interesting addition to the scheme in the concluding stages of the work, so as to accord with standard signalling practice laid down by the Railway Executive, is that all intermediate shunt signals are cleared before a main signal can be cleared for a running movement. In addition to the signals themselves, special "train ready to start" indicators are provided for expediting the working with long trains at the busy curving platforms, where engine drivers are often out of sight of the guard at the rear end. Plungers are installed whereby the front guard, or inspector, can illuminate an indicator at the rear end of the platform to show "ready". The rear guard thereupon signals the "right- away" to the driver by pressing another plunger which cancels the ready indication, illuminates a letter "S" at the head end of the platform, at the same time ringing a bell. The driver is then free to start as soon as the appropriate signal clears.

The points are operated by the mechanism illustrated in Fig. 2. This is a typical electro-pneumatic lay-out, of which several variations are to be seen at York, to suit single-slip, double-slip, or movable switch diamond points. Where only a single pair of points has to be moved the operating cylinders are 5in. diameter, but 6in cylinders are used for double slips or movable diamonds. In the earliest installations of electro-pneumatic signalling the control valves were such that air was maintained on one side or other of the piston all the time, and, to minimise leakage, cup leathers were used for the piston packings. At York, as in all modern installations, the control valves are of the "cut-off" type, and metallic packings are used for the pistons. The drive from the cylinder to the points is through a single escapement gear, as shown in Fig. 4, and in the majority of lay-outs the facing point lock and the electric point detector are mounted in the "six-foot" way. The junctions at the south end of the area, beyond the southernmost extent of the electro-pneumatic working, are operated by electric point operating machines, most of which have the facing point lock and detector integral with the mechanism.

The point control valve is known as the "CP," and is designed so that the air supply to the cylinder is cut off immediately the switch movement is completed. Some details of this valve are shown in the drawing Fig. 5. There are three magnet valves, as shown in Fig. 5—normal control, reverse control, and the lock magnet. The control magnets are energised either through contacts on the appropriate point lever or, in the case of a relay interlocking through contacts on the relay concerned. It is through the lock magnet that the immediate cutting off of the air supply is effected, since this magnet is energised through the back contacts of the point indication relay. This magnet is energised at first by the reversal of the cabin lever, or the reversal of the point control relay. This admits air—in the case of a point movement from normal to reverse—to the reverse control piston, and at the same time as air is admitted to the cylinder the movement of the control piston actuates the floating beam *C* and reverses the contacts. When the points have thrown, and the indication relay is energised once again, the lock magnet is de-energised and air supply to the cylinder is cut off.

THE CONTROL PANEL

As the centre piece of the whole installation, the new control panel shown in Fig. 6 is of exceptional interest. We have several times previously referred to the Westinghouse route relay interlocking system, in which only one control switch needs to be operated in order to set up a route; but, in view of its incorporation in so large a control panel, a more detailed description of the principles of operation will be appropriate. For this purpose an actual example from the York installation has been taken, namely, that of signal 109. The tracks concerned and adjacent signals are shown in Fig. 7. On the sloping keyboard of the control panel there are separate thumb switches for each of the eight routes leading from this signal; in accordance with usual practice the main running signal route switches are coloured red, and those of the subsidiaries are white. The method of grouping these switches on the keyboard is shown at the right-hand side of Fig. 7.

The main running signal can read to any one of five routes, and some impression of the saving in lever movements resulting from the use of the route system can be gathered from the accompanying table, which shows the number of points concerned in each of the five routes.

Route Signalling System

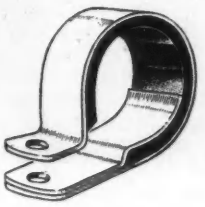
Route No.	Direction	Furthest extent	No. of points
109–1	To up Leeds main	Signal 35	13
109–2	To up Doncaster main via 481 reversed	Signal 36	14
109–3	To up Holgate loop via 481 reversed	Signal 30	14
109–4	To up Doncaster via 481 normal	Signal 36	10
109–5	To up Holgate loop via 481 normal	Signal 30	9

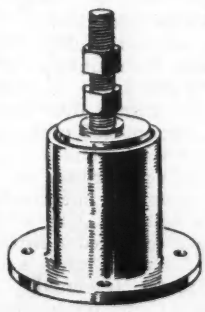
(To be continued)

Anti-Vibration Clips and Mountings

A RECENT addition to the range of motor-car and aircraft components produced by Howard Clayton-Wright, Ltd., of Wellesbourne, Warwickshire, is a useful little anti-vibration clip for securing all forms of pipes, conduits and cables.

Two kinds of these "Claytonrite" clips are made for holding pipes or cables from $\frac{3}{16}$in to $1\frac{1}{2}$in outside diameter. They consist essentially of a metal clip of the familiar shape, but have bonded round the inner gripping surface a strip of rubber, which holds the pipe firmly and serves to damp down mechanical vibrations likely to cause "creep" or "hammering." One of the clips is made with a fully rubber-lined gripping surface.; the other, to be seen in the illustration below, is provided with a metal tongue, which extends part of the way round a conduit or cable to form an electrical earthing contact where complete insulation is not desired.





ANTI-VIBRATION CLIP AND MACHINE MOUNTING

This firm is now also making twelve standard sizes of its "Vibro-Dampers" in capacities from 10 lb to 2000 lb for machine mounting purposes. These dampers are of simple yet effective design, as can be seen from the second illustration.

They consist essentially of a flanged base, which can be bolted to the floor, and which has an internal column connected to it by a heavy bush of bonded rubber. Integral with the column is a threaded stud, on which the machine is supported between two nuts. The lower nut can be set at any required position to level up a machine before it is rigidly clamped by screwing down the upper nut. Thus the units can be used for the dual purpose of levelling machines on foundations which are slightly out of alignment, as well as for damping vibrations.

Exhibition of Industrial Power at Kelvin Hall

No. II—(*Continued from page 729, June 1st*)

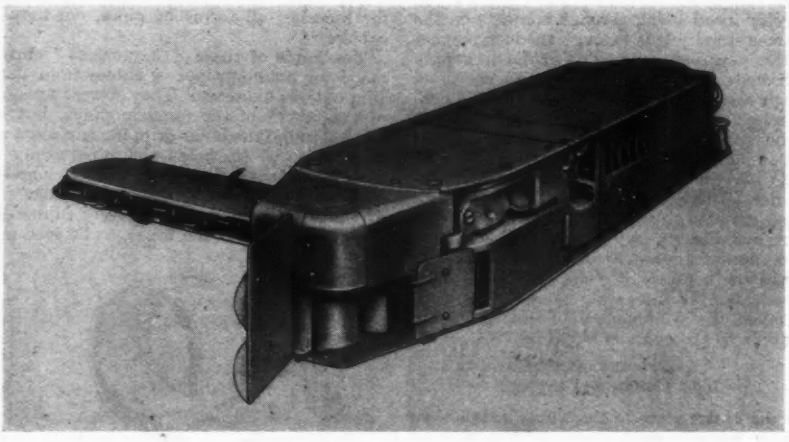
Shipbuilding and Railways

THE coal and water sequences unite and enter the hall of shipbuilding and railways, where the part played by Britain in both spheres of activity are demonstrated, with railways on the ground floor and shipbuilding on an upper level. Facing the entrance is a very large representation of the bows of a ship.

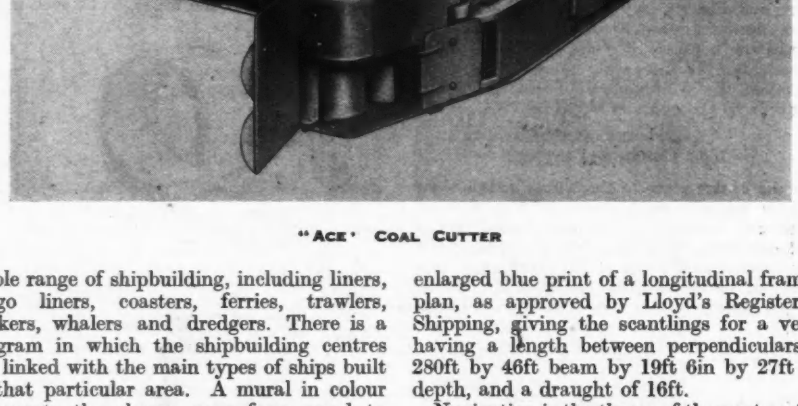
Shipbuilding.—A stainless steel propeller is the first exhibit and on a gallery are displayed a number of ship models covering the whole range of shipbuilding, including liners, cargo liners, coasters, ferries, trawlers, tankers, whalers and dredgers. There is a diagram in which the shipbuilding centres are linked with the main types of ships built in that particular area. A mural in colour represents the change over from wood to steel and the ancient craft of the shipwright in constructing a wooden hull is contrasted with steel shipbuilding. Britain as a shipowner and trader is depicted in a number of showcases, which tell the story of the infinite variety of cargoes carried in British ships and handled at the ports, while a globe shows the trade routes traversed. A spacious vertical screen shows the historical build-up of Britain's supremacy at sea. Represented there, are the fleet of Henry V, the Trinity House charter granted by Henry VIII, the Elizabethan era, Pepys, the composite shipbuilding and multi-screw of Scott Russell, Brunel, Froude, Watt (with his steam engine), and Parsons (with his turbine).

Next, almost running the length of the hall, comes a sequence which outlines the story of how a ship is born. This is traced from the first sketches on the drawing board through the building stages to the launch and completion afloat, ready for the maiden voyage. The technique and complexities of shipbuilding are demonstrated together with the precautions which are taken to ensure safety of life at sea. Above is a vertical mural consisting of an enormously enlarged blue print of a longitudinal framing plan, as approved by Lloyd's Register of Shipping, giving the scantlings for a vessel having a length between perpendiculars of 280ft by 46ft beam by 19ft 6in by 27ft 6in depth, and a draught of 16ft.

Navigation is the theme of the next section which recounts the history of the methods of determination of latitude and longitude and evolution of the compass. A large three-deck structure in the centre of the hall has a ship's bridge laid out on the top deck and the operation of the steering telemotor controls a seascape film, shown on a screen in front of the wheelhouse windows, to create the effect of the ship answering the helm. Below is a space equipped as a ship's lounge with token fittings, and below that again is a ship's engine-room with a modern oil engine and auxiliaries. The final length of gallery shows the latest navigation aids, including an echo sounder, direction finding equipment and radar, all of which have animated wall panels which demonstrate the working of the various devices.

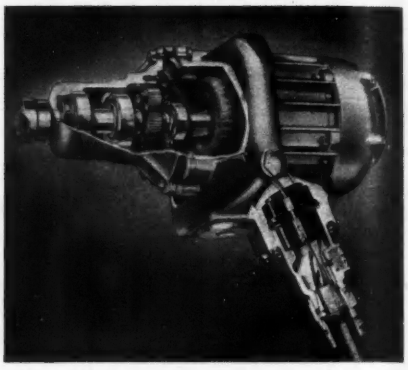


"Ace" Coal Cutter



A.B. Meco-Moore Cutter Loader

Railways.—In the railway section stress is laid upon the role played by Britain in inventing and developing the locomotives and the railway systems of the world. Early history is emphasised with special reference to Richard Trevithick, who produced the first steam carriage in 1804. Historical notices, such as the opening of the Surrey Iron Railway, are on view and prints of early locomotives, including Hadley's "Puffing Billy" and Brunton's "Mechanical Traveller," illustrating smooth wheel, toothed wheel and oscillating legs as methods of propulsion. Stephenson's "Blucher" (1814) at Killingworth Colliery and the Stockton and Darlington Railway (1825) are illustrated and also the engine "Locomotion," which pulled the first public steam train in the world. The section closes with a scale model of Wylam Dilly locomotive. The original Ackroyd Stuart oil engine is on view and contrasted with its modern counterpart. A diesel railcar engine and a deisel shunting locomotive typify oil engine traction. On the far side of the hall railway engineering forms the main subject of the exhibits, made up of prints and photographs. R. Stephenson's iron bridge at West Auckland is shown, also the Stockton-Darlington suspension bridge (1830), the Colebrook viaduct (1843), the Britannia bridge (1849) and examples of the work of Brunel. Included in the display is a pictorial record of a number of spectacular bridge building achievements abroad. A showcase contains a number of models of steam, diesel, diesel-electric, electric, and gas turbine locomotives, demonstrating the wide range of British designed and built units exported to the railways of the world. The next section deals exclusively with the wide variety of tickets issued over the years by the railway companies and associated steamer services, and is followed by a gallery in which the emphasis is on the passengers. A series of mockups show modern examples of passenger coaches and includes the all-aluminium alloy coach for the London underground services, a dining coach, an Indian Government Railways multiple-uhit electric motor-car for use on suburban systems, and a coach for service on the Bombay, Baroda and Central Indian Railway. The hall is dominated by the penultimate exhibit, which is a 4–6–4 "R" class steam locomotive and the property of the Government of Victoria, Australia. Finally, there is an elaborate model railway.



Electric Rotary Drill

Hall of the Future

Through apertures in the floor of the hall the work of the pioneers of

the past can be seen. There are five pits and each deals with the discoveries which have advanced heavy engineering. James Watt, who invented the first efficient steam engine by incorporating a separate condenser; Richard Trevithick, "the father of the steam locomotive"; Michael Faraday, whose work led to the development of dynamo-electric machinery; Sir Charles Parsons, the inventor of the turbine; and Lord Rutherford, who established the mechanism of radio-active transformations.

The central feature is a cone, concealing a "Tesla" insulation tester, from the tip of which 1,000,000V flashes of "lightning" crackle to the ceiling; around the base of the cone a series of panels explain the process of releasing atomic energy.

Having completed a general survey of the exhibition, we turn our attention to some of the individual exhibits in the sequence of halls.

Hall of Coal

In the modern mining section a number of machines are on view to demonstrate the new techniques employed in winning coal where the face depth is sufficient for the introduction of mechanical aids. The "Ace" coal cutter and gummer made by British Jeffrey-Diamond, Ltd., which we illustrate, is of three-unit construction, held together by high-tensile steel bolts and consists of a haulage unit, a driving unit and a sliding jib and cutting chain, all resting upon a sledge plate. The machine, which is available for compressed air as well as electric drive, has a gummer attachment, which is an automatic kerf cleaner. The machine and gummer have an overall length of 10ft 10in and a net weight of 2 tons 15 cwt.

The haulage end gearcase is a steel casting and incorporates a flameproof terminal chamber for the switch leads. There are two haulage speeds, a variable slow speed for cutting and a reversible fast speed for flitting, the gears being always in mesh. The drive is through a single helical spur gear, a bevel gear and straight spur gears to the rope drum, which takes 25 yards of ⅝in diameter wire rope. For cutting, a ratchet and pawl drive is engaged and, for flitting, a spur gear drive. An epicyclic gear in the rope drum effects the final reduction and the planet gear carrier is shaped to form a brake drum, which is held by a hand brake set to allow a maximum rope pull of 12,000 lb. The gear operates smoothly, having an automatic pick-up and slipping action, which is useful for positioning the machine for jibbing in or when turning. The epicyclic gear and rope drum assembly are totally enclosed and mounted on roller bearings. There are three ranges of cutting speeds, each arranged in five steps, and three corresponding flitting speeds.

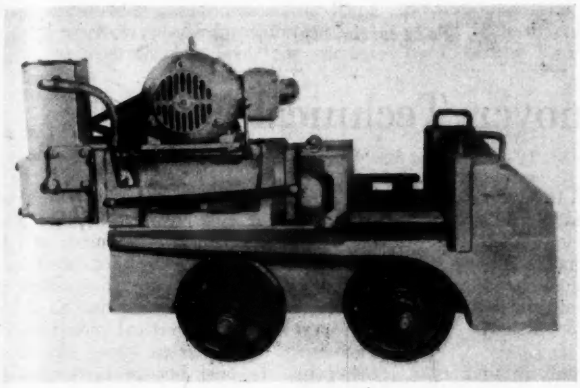
A three-phase, 50 c/s, 60 h.p., one hour rated motor running at 1475 r.p.m. forms the driving unit and has a starting torque of two and one-half times full load torque, while the starting current (instantaneous) is five-and-a-half times full load requirements. The stator frame is of cast steel. The double squirrel-cage rotor has its outer cage immediately outside the inner cage, the rotor bars of which are of pure electrolytic copper while those of the outer cage are of phosphor-bronze. The rotor is mounted on ball and roller bearings housed in cast steel end brackets.

The cast steel cutting end is arranged with ample clearance space for cuttings, so that the machine cuts freely without close shovelling. There are three gear reductions; the first and second are straight spur gears from the motor and the third a bevel drive to the sprocket shaft, and a locking device keeps the gears in mesh against any accidental contact with the coal face. The jib casting is of turret pattern, having ample bearing surface, while the jib itself can be locked for cutting to right or left or in line with the machine for flitting. For automatic kerf cleaning an easily fitted gummer is provided; this sweeps the chain cuttings clear and discharges them in piles so placed that ample room is available for cogging and timbering. The cowl, cowl housing and gearbox are of steel; the gearbox enclosing a spur and bevel gear driven from the cutting end. In the cowl are three independent blades, eccentrically mounted so that the blades extend and retract, the fully extended position being at the point nearest to the cutter chain.

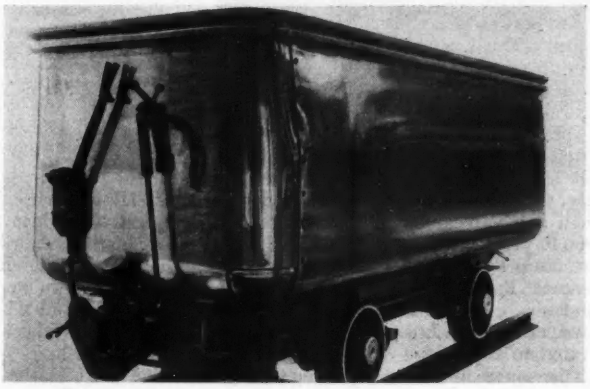
Another machine is the A.B. Meco-Moore cutter loader, jointly produced by the Mining Engineering Company, Ltd., and Anderson, Boyes and Co., Ltd., which is similar to the machine on view in the Minerals of the Island Pavilion at the South Bank Exhibition described in this week's issue.

Among the small tools illustrated herewith, is a 125V, three-phase, 50 c/s electric drill, manufactured by Victor Products (Wallsend), Ltd., which weighs 38 lb when used for coal and 43 lb when adapted as a light stone drill. The tool gives 70 per cent of maximum torque with minimum slip and has a stalling torque of 25 lb/ft, the current consumption being 8A at light load and the temperature rise 18 deg. Cent. after running a half hour, under average coal conditions, requiring 12½ lb/ft torque. The gearbox is readily removable without destroying flameproof qualities and the epicyclic gears are of molybdenum-chrome steel.

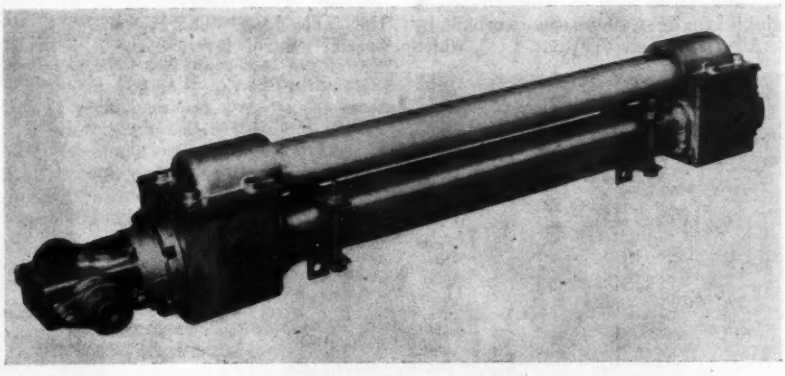
The increasing amount of underground mechanisation has increased the use of arched girders and steel props for roadway and face support. Through being set initially in unsettled ground, distortion occurs, so that the girders have to be withdrawn for reconditioning or reforming for duties elsewhere. Such work can be carried out on site by the portable arch bender (manufactured by the Finlay Conveyor Company, Ltd.,) which is on view and illustrated on this page. The exhibit is the standard flameproof electric model mounted on rail wheels and measures 5ft 10in long by 3ft wide by 40in high, the weight being about 33 cwt. The



Portable Arch Bender



Light Alloy Mine Car



Flameproof Fluorescent Lamp

ram can exert a pressure of 60 tons, sufficient to bend or straighten sections up to 60 lb per yard, and the adjustable bending blocks permit the reconditioning of twisted sections without the use of special tools.

The press unit consists of a horizontal ram, cylinder, pump assembly and power drive. A hand lever controls the ram movement by operating the pressure control valve through a rotating cam and thus regulates the oil supply from twin pumps. A spring-loaded safety valve set to operate at maximum working pressure protects the cylinder against overload. Cast in special high-tensile close-grained iron, the ram cylinder is machined to mount the motor and pump assembly. A crosshead is attached to the cast steel ram head, which is fitted to the polished steel ram. This has a working speed of 14in per minute and has two heavy tension return springs. A vee rope drive from a 3 h.p. electric motor running at 950 r.p.m. transmits power to the two plunger pumps operated by a two-throw camshaft through tappet levers. Running at 450 strokes per minute, the pumps deliver oil to the cylinder through ball valves at a maxmum pressure of 6000 lb per square inch.

For mine lighting there is a pneumatic fluorescent lighting fitting complete with compressor. The compressor, by Alfred Bullows and Sons, Ltd., is semi-automatic and rated to supply 8·4 cubic feet of air at 100 lb per square inch. After passing through a filter the air drives a turbo-generator incorporated in the lamp fitting, which contains two 18in, 15W fluorescent tubes. Another design of lamp exhibited is the 40W, 2ft fluorescent lighting fitting, produced by the British Thomson-Houston Company, Ltd., and seen in one of our illustrations. The main assembly consists of an extruded aluminium back channel welded to cast end boxes, with the auxiliary gear mounted on a sub-chassis housed in the main channel. Although the lamp will not ignite fire-damp, there is a safety switch behind the lampholders and with the lamp in position these safety switches are closed, but the switch contacts automatically open to isolate the filaments immediately the lamp is fractured or removed.

The latest developments in the underground transport of coal is demonstrated in the exhibit of a light alloy mine car, built by W. G. Allen and Sons (Tipton), Ltd., which has a pay load capacity of 2½ tons. Body and frame are constructed of aluminium alloy, while the couplers, and coupler seatings are of steel. Timken taper roller bearings are fitted in the axle hubs, the axles being of axle steel and the wheels of cast steel. The car is spring loaded, the laminated steel springs being housed in the aluminium alloy frame channels, and the cast steel axle block slides in cast aluminium alloy horn guides. Independently operated parking brakes are fitted, each acting on two wheels, the brake rigging employing the "Bowden" cable system. The car, as illustrated, has a length over buffers of 10ft, an overall height of 4ft 6in, an overall width of 3ft 9in, with a wheel base of 4ft, and has a tare weight of 17½ cwt, compared with 25½ cwt for an all-steel car. A 100 b.h.p. diesel flameproof mines locomotive, built by the North British Locomotive Company, Ltd., and described in our issue of June 1st, is on view, typifying modern underground power haulage. The weight of the locomotive can be varied between 12½ and 15 tons and the track gauge adjusted from 2ft 8½in to 3ft 6in. The following are the main particulars:—The length over the buffer beams is 15ft 1in, width 4ft, height 4ft 5in, wheel base 4ft 7in, minimum radius of curved track 45ft, maximum speed 12½ m.p.h., and tractive effort 8400 lb.

(To be continued)

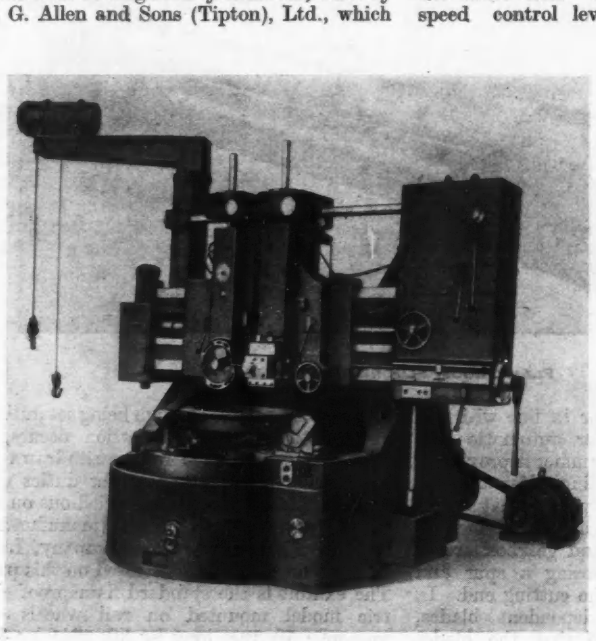
Hanover Technical Fair

No. IV—*(Continued from page 732, June 1st)*

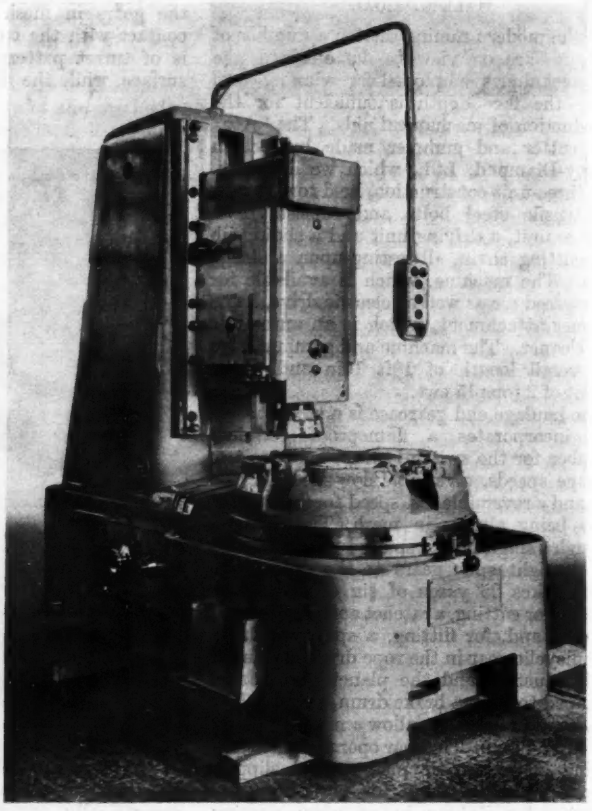
A FIRM which exhibited this year for the first time since the end of the war was the Maschinenfabrik Froriep G.m.b.H., of Rheydt, in the Rhineland. Among the machines shown were the company's vertical turret lathe and a boring mill for locomotive and carriage-wheel tyres, which we illustrate herewith.

The turret lathes are built in four sizes, with table diameters of 1000mm, 1250mm, 1400mm and 1600mm, respectively. They have eighteen table speeds, ranging from 2·24 r.p.m. up to 180 r.p.m., and the small machine can also be supplied as a high-speed unit, with table speeds from 7 r.p.m. up to 350 r.p.m. Each of the machines has a pendant push-button control box, so positioned that the attendant can give very close attention to his work. The tables of the machines are strongly built and run in a steel bed, lined with anti-friction metal. The driving spindle is housed in a double-row of adjustable roller bearings and is carried on an adjustable ball thrust bearing, which takes the table load. The speed control levers are neatly grouped on one side below the table and a Kienzle preselector gear is fitted. In addition to the cross rail head there is a side head and each head has its own feed and speed controls. The cross rail head can be inclined up to 45 deg. either side of its vertical position. The movement of the cross slide, like that of the table, is push-button controlled from the pendant. Vernier scales for making fine adjustments are also provided. Turret lathes of the kind described can also be supplied equipped with thread-cutting and taper turning mechanisms.

The locomotive tyre boring mill is one of three models designed to bore and finish wheel-tyres, having diameters of 1100mm, 1700mm and 2100mm, respectively. The work is held on to the table by three pneumatically operated clamps. As will be seen

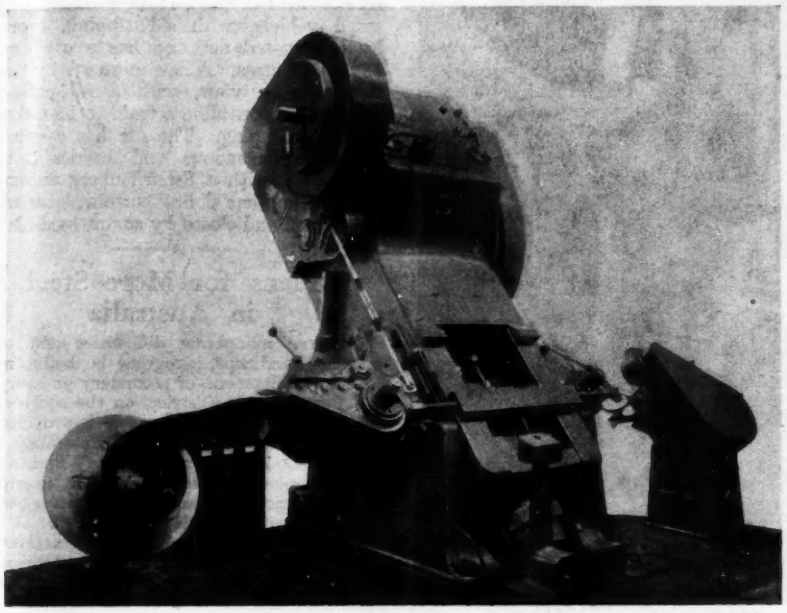


BORING MILL FOR TYRES—FRORIEP



VERTICAL MILLING MACHINE—HELLER

from our illustration, the cross slide carries two heads. The left-hand head carries two tools for cutting the retaining ring groove and a third for turning the lower lip. At the same time tools on the right-hand head rough out the bore, the upper tool dealing with the main bore, while the lower tool deals with the smaller diameter of the lower part. When roughing is completed the right-hand head tool takes a finishing cut, while the left-hand head is stationary. The machine has been designed to work as a semi-automatic and all its movements are electrically controlled to follow in the right sequence. Provision is made for using either tipped tools or high-speed steel tools, and the controls include a speed selection lever for giving correct speeds for different diameter tyres and another lever for correct speeds for either type of tool. Both kinds of tool can be used for roughing cuts but only high speed steel tools are employed for finishing cuts. The controls deal automatically with the speed and feed changes and the rapid movements of the tool-heads.



INCLINABLE CRANK PRESS—KIESERLING

As already described, the tool-heads generally work together but they can also be operated separately and can be readily adapted for both vertical and horizontal turning facilities. The agents for Maschinenfabrik Froriep G.m.b.H. in Great Britain are B.E.L.A. Machine Tools, Ltd., of 90, Victoria Street, London, S.W.1.

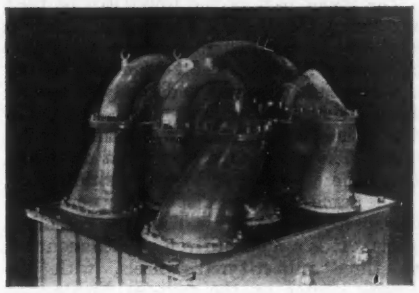
An unusually interesting machine for shipbuilders and structural engineers was exhibited by the joint firms of Schichau A.G. and Dr. Böger K.G., of Bremerhaven-Mitte. This machine, called the "Schichau Monopol," is a fully automatic photo-electrically controlled gas-burning and marking-out machine, designed to work from a photographic negative of a scale drawing, and to deal with steel plates of any shape or curve, with a width of 6ft 6in and a length up to 33ft. It can be equipped as a plate-burning machine or fitted with automatic welding devices or a marking-out unit.

On the stand of Th. Kieserling and Albrecht, of Solingen, there was shown a new geared, inclinable crank press, "KPRN 160," which we illustrate herewith. The frame of the press forms a closed structure and at each side has openings for the introduction of the steel strip and the passage of the punched strip to the scrap-cutting unit. The frame is carried in a strong base-member, which holds it firm in any position up to 45 deg., the extreme angle of inclination. The tilting mechanism comprises motor-driven worm gear with inclining spindles and the motion is push-button controlled. The press has a very long ram, which is supported in adjustable slides, between the side supports and again beyond the crankshaft by a smaller diameter support, which also serves as a compressed air balancing cylinder. The ram has an adjustable stroke and, as a provision against possible overloads, a safety disc is provided, which, if fractured, can be simply replaced by loosening four screws. The gear drive to the crankshaft is through herring-bone gearing and incorporated with the flywheel is the pneumatically operated dry-plate clutch and brake. On the left side of the press will be seen the roller feed mechanism for the incoming steel strip and on the right the feed for the punched strip to the scrap cutter. Both feed mechanisms are driven directly from the crankshaft and can be adjusted to suit different heights of tools.

The firm also displayed a model of its double-action expanding drawing press, type KZU, with its drive below the floor level. The London agent of Th. Kieserling and Albrecht is Mr. F. W. Kubach, of 12, Sylvan Road, London, S.E.19.

Gebrüder Heller Maschinenfabrik G.m.b.H. of Nürtingen, Würtemberg, showed a wide range of cold-sawing and milling machines. Particular interest attaches to the development of different forms of Heller milling machines with the firm's drive both for the table and the milling heads. The largest machine shown was a long milling machine, with one vertical and two horizontal milling heads. In each head there is a hydraulic motor, which drives two sets of speed reductions, one with gears and the other with belts, to give six spindle speeds. We illustrate one of the firm's vertical machines with a circular table fitted with a standard milling head. The firm of Gebrüder Heller is represented in Great Britain by A. C. Wickman, Ltd., of Coventry.

The Demag Aktiengesellschaft, of Duisburg, showed a full range of its products, among which we noted a new design of four-stage air compressor designed for mining work. One of these units is shown herewith. The motor shaft drives a central gearwheel, which meshes with pinion shafts on either side. The two pinion shafts carry at each end an overhung impeller, which revolves in a spiral casing, flanged to the gearcase. The four-stage impellers are connected in series with an intercooler, which is interposed between each two impellers. The baseplate serves as a housing for the intercooler elements and it also contains an oil reservoir. A geared pump driven from the gearshaft draws the lubricating oil from the reservoir and delivers it to the bearings of the gearwheel and pinion shafts through a cooler and a changeover filter.

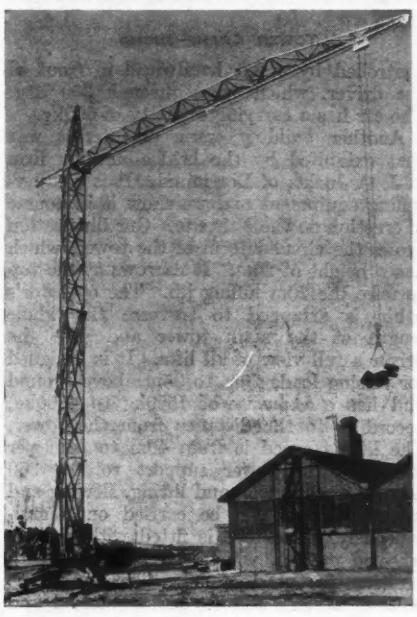


FOUR-STAGE MINING AIR COMPRESSOR —DEMAG

The Demag Aktiengesellschaft is represented in Great Britain by Mannex (London), Ltd., of 54, Victoria Street, S.W.1.

Among the large number of outside exhibits were several examples of new kinds of cranes, the design and construction of which has been greatly stimulated by the large programme of new building and building repair work now being undertaken in all parts of Germany.

The Aktiengesellschaft für Bergbau und Hüttenbedarf, of Salzgitter in the Harz, showed a universal building crane, which is illustrated on this page. It is a combined arrangement of a luffing crane and a crane with a horizontal jib and a



UNIVERSAL BUILDING CRANE—SALZGITTER

travelling crab and hook. It is a mobile unit and can be erected and put to work on a building site in about half-an-hour. The radius served by the crane is 15m. The maximum lifting height as a luffing crane is 28m and the hook loading is 700kg at a reach of 15m and 1000kg at 10m. The triangular tower mast has lattice cross-bracing and is designed to give the necessary torsional stiffness and strength for all conditions of crane loading.

The upper part of the tower can be used as a luffing jib at small heights and the main mast can be adapted to serve as a building hoist when needed. The bottom part of the mast consists of a stiff underbody or spider, with a six-point support, which accommodates the ballast and the hoisting machinery. The crane is driven by a 25 b.h.p. Deutz diesel engine or by an electric motor.

The same firm also displayed a new small transporter or loader called the "Coolie" roller. It is a motor-driven vehicle mounted on three rubber-tyred wheels, with the driving motor at the rear—a Fichte and Sachs two-stroke petrol engine. It is

TOWER CRANE—JUCHO

controlled by a flat handwheel in front of the driver, which turns through 360 deg. The car has a carrying capacity of 600kg.

Another building crane of interest was that exhibited by the bridge-building firm of J. C. Jucho, of Dortmund. It is a tower-luffing equipment and we show it in course of erection on the Fair site. Our illustration shows the circular form of the tower, which has a height of 20m. It narrows at the top to take the 20m luffing jib. The operator's cabin is arranged to traverse the whole length of the main tower and give the driver a full view of all lifts. It is designed for raising loads 20m to 35m above ground and has a capacity of 1500kg to 4000kg, according to the distance from the tower. The lifting speed is from 40m to 14m per minute. The tower support rotates 360 deg. on a roller ring and lifting, slewing and luffing motions can be carried out simultaneously. The base is fitted with rubber-wheeled castors, which can be jacked into position for road travel. The automatic balance weights for the luffing motion and the ballast are accommodated in the base behind the hoisting machinery.

The crane was demonstrated operating on a curved rail with a radius of only 3·5m. When travelling, the tower and the jib fold down into a horizontal position and the crane can be raised and erected with its own hoisting gear.

An unusual exhibit was the brick-throwing machine, styled the "Seegers Thrower," which was shown by the Leichtmetall G.m.b.H., of Sulingen. Its function is to help bricklayers by projecting such objects as bricks and roofing-tiles up to heights of 20m. As our illustration shows, the brick to be thrown rests on a slide, which is trained to the line of flight. A

BRICK THROWING MACHINE—LEICHTMETALL

small electric motor or internal combustion engine pulls back the slide by a rack mechanism and in so doing stretches two large rubber springs. At the desired point in its path the slide containing the brick is released and it flies upwards, ejecting the brick, the slide being braked by an air cylinder in the cylindrical guide. The velocity is so regulated that the brick is dropped on the platform just as it reaches the top of its trajectory. With this machine bricks can be piled on a platform at any given height or they may be caught by the bricklayer and stacked. The capacity of the machine is 1500 bricks per hour.

Finally, brief reference may be made to some of the prime movers shown. The Spillingwerk, of Hamburg II, Werftstrasse 5, displayed further developments in the design and construction of high-speed, light steam engines for marine and industrial uses.

The Maschinenfabrik Meer A.G., of München Gladbach, in a special pavilion, exhibited a completely enclosed three-crank steam engine with a designed output of 600 b.h.p., a speed of 500 r.p.m., direct coupled to a 500kVA three-phase alternator.

The M.A.N. Company showed a range of supercharged diesel engines, which included a 7000 b.h.p., 125 r.p.m. marine engine and a 1500 b.h.p., 700 r.p.m. locomotive engine, which is also used for peak load and marine auxiliary purposes. Among the M.A.N. pumps we noted a large axial pump just completed by the Guatavsburg works, for irrigation purposes in Egypt. It has a designed output of 8000 litres per second. Another new pump was the M.A.N. S-pump, which has recently been produced to handle stones and mud, when clearing canals and rivers. It has an injector at the bottom of the suction pipe, the action of which entrains with the water all solid material. The M.A.N. Company is represented in London by C. Wykeham and Co., 17/19, Cockspur Street, S.W.1.

The Daimler Benz Aktiengesellschaft, of Stuttgart-Untertürkheim, showed two examples of modern diesel engines for high-speed boats. They included a four-cylinder, 50–90 b.h.p. engine running at 550 r.p.m. to 1000 r.p.m., and a six-cylinder, 50–60 b.h.p. engine running at 1200 r.p.m. to 1500 r.p.m. Both engines were complete with reversing and reduction gear.

There was a large exhibit by Krupp, of Essen, which included locomotives and one of the largest tipping wagons in railway service in Europe. It is a 52-ton, eight-axled vehicle, with side-tipping, operated by compressed air, and has a capacity of 73 cubic metres. A new mine car by Krupp was also on view, with a self-unloading arrangement enabling a train to be unloaded without stopping. The car has a capacity of 3.5 cubic metres and carries 3 tons. It is fitted with a Scharffenberg automatic coupling and has sliding bottom plates, which are opened and closed by compressed air.

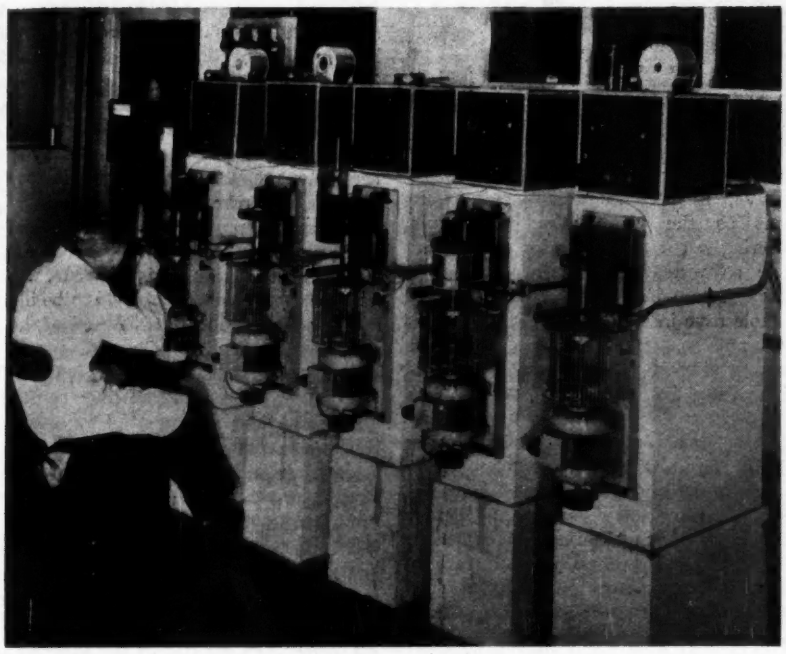
Plans for More Steel in Australia

DESPITE manpower difficulties and other current handicaps, progress is being made in the development of secondary industry in the Port Kembla District, on the south coast of N.S.W. A notable example is provided by the ambitious programme of Australian Iron and Steel, Ltd. Twenty-four Wilputte by-product coke ovens are being built to supplement the output of the forty-eight ovens which have been in operation since 1949. A new blast furnace, also in course of construction, will handle 1500 tons of iron daily. There are also to be two 240-ton open hearth furnaces, whose equipment will include a 100-ton hot metal crane and two 225-ton ladle cranes. The company reports also that "the first section of the hot strip mill is proceeding. Already some 750,000 cubic yards of filling have been placed and 500,000 cubic yards of sand are being pumped from the site to the proposed inner harbour. Because of the nature of the ground, all equipment and buildings have to be supported on piles. Steel piles are used, the length varying from 20ft to 90ft. Some 3000 of these piles required for the hot roughing mill have already been driven. A start has been made on the tinplate warehouse foundations and the steelwork is on hand for erection. Completion of this programme of development at Kembla's steelworks and collieries will increase the Australian steel industry's annual capacity from 1,750,000 tons to 2,300,000 tons and will make Port Kembla one of the world's most modern and comprehensive steel-producing centres."

JUNIOR INSTITUTION OF ENGINEERS' SCHOLARSHIPS.—The Junior Institution of Engineers announces that, through the generosity of the Maudslay Society, it has been enabled to offer a scholarship to young engineers for the purpose of assisting them in their technical education and practical training. Under this "Maudslay Scholarship" a sum of £125 is awarded for one year and will be awarded by selection to a candidate not more than twenty-five years of age who is an engineer or training to be an engineer mainly in mechanical engineering. The money may be expended in any way the holder may desire, subject to approval, and it may be renewable for a further period of one or two years. Applications should be made to the secretary of the Institution not later than July 31st. The Institution is now also offering for annual competition the Durham Bursary of the value of £20 in cash.

The Tin Research Institute

ON Thursday of last week H.R.H. the Duke of Gloucester, formally opened the laboratories of the Tin Research Institute, Greenford, Middlesex, which serve also as the headquarters of the Tin Research and Development Council. This Council is an organisation financed by the tin mining companies of six countries and the researches of the Institute are directed to develop and promote the uses of tin, its alloys and compounds. The Council was formed in 1927 and its research was mainly of an extra-mural nature until, in 1938, part of the present building was opened. Its most notable contributions, subsequently, to electro-chemistry have been connected with the electro-deposition of tin alloys and the commercial processes associated with this technique.



FATIGUE TESTING MACHINES

The new building comprises three floors, the ground floor having been partitioned into three bays, running lengthwise, each bay housing several laboratories. In the central bay is the general metallurgical laboratory, containing much of the heavier metal working equipment. There are three induction furnaces of 10 lb, 25 lb and 100 lb capacity, a 100-ton hydraulic press for forging or for compacting powdered metals, and a tin alloy strip rolling mill, with other equipment. In one of the adjacent bays are the electrochemical laboratory and the plating workshop, the latter housing full-size plating plant. Three methods of tin plating are in use, the sodium stannate bath, the stannous sulphate bath and the stannous fluoborate bath. Baths for copper plating and cadmium plating are also available.

Three processes of tin alloy deposition have been developed by the Institute. The tin-zinc alloy plating (78 per cent tin) is used to protect steel against corrosion and is stated to give generally better protection than cadmium or zinc and is relatively cheaper than the former. Speculum plating, containing about 40 per cent tin and 60 per cent copper, has a more decorative, white finish and is used for cutlery and ornamental work. Both processes are now commercially operated in many parts of the world.

The most recent plating to be developed, and now undergoing commercial trials, is a coating made by electro-deposition from a solution containing chlorides and fluorides. It contains 65 per cent tin and 35 per cent nickel, and combines a beautiful metallic lustre with a faint rose-pink colour. It is deposited in a bright condition, requiring little or no polishing, is hard, and untarnished by even polluted atmospheres.

The circulating electrolyte cell to be used as a model for studying the effect of annealing, cleaning and plating conditions on electro-tinplate manufacture, is not yet in operation but most of the heavy constructional work on this installation is now finished. Current up to 350A per square foot and electrolyte speeds of 50–500ft per minute are to be used.

The electrochemical research laboratory contains a Hull cell, devised so that metal may be deposited at various current densities throughout the length of a single specimen in one operation. There has also been developed a valve voltmeter to read directly small voltage changes, and other equipment is installed for power consumption measurements in electroplating processes.

Arranged in the other bay on this floor are a number of smaller laboratories, the workshop and the mechanical testing laboratories. There is a tin-plate laboratory for examining the condition of finished plating. It uses four methods of measuring the thickness of tin coatings in one of which—the Francis test—the change in electrode potential which occurs when the tin coating is completely stripped from the underlying steel is amplified electronically and the impulse is used to stop the stripping action and record the thickness automatically.

For determining the porosity of a coating there are three methods; one method being the Thiocyanate test. Iron exposed at microscopic pores in the tin coating is attacked by an acid solution of ammonium thiocyanate and produces the characteristic red colour of iron thiocyanate. An index of the coating continuity is got by measuring the depth of colour with comparator tubes or by a Spekker absorptiometer.

The mechanical testing laboratory has the normal Rockwell, Vickers, Avery, Hounsfield and Denison equipment. Fatigue investigations are conducted with several forms of equipment. On the Underwood bearing testing machine the bearings under test are mounted in two connecting-rods in the centre of the machines. The shaft carries eccentric weights and the bearings are subjected to alternating loads. The temperature of the oil is controlled and the load on each bearing is measured by strain gauges. The machines, which we illustrate, are designed for the testing of tin alloys at temperatures up to 200 deg. Cent. The specimen is a cantilever subject to rapidly alternating stress applied by a revolving eccentric weight. A typical test involves 100 million reversals of stress over a period of about three weeks.

Access to the first and second floors can be gained by a lift. On the first floor are situated the photographic studio, bureau, library and main hall; the second floor is occupied by further analytical and corrosion laboratories. In the analytical laboratory there is apparatus for measuring small quantities of metals in solution of the order of a few parts per million. With the polarographic analysis an electric current at a slowly increasing voltage is passed through the solution. When the voltage is sufficient to plate out a metal constituent there is a sudden increase of current. By electronic multiplication these changes can be recorded and the exact amount of each metal assessed.

Another method is the use of a photoelectric absorptiometer in conjunction with suitable reagents.

The corrosive properties of tin alloys are undergoing exhaustive investigation. Part of this work has been concerned with the application of a tin coating (0·00005in thick) to steel before painting. Other apparatus includes that for measuring the minute flow of electricity associated with electroplating processes.

There are also a number of chambers in which intensified atmospheric corrosion conditions are simulated under exact control.

Borough Engineers and Trade Union Membership

THE Engineers' Guild has addressed a letter to the Edmonton Borough Council, protesting against a condition relating to the appointment of a Borough Engineer and Surveyor. The condition in question reads:—"The person appointed shall during the term of his employment by the Council be and continue to be a member of a trade union affiliated to or specified by the Trades Union Congress or eligible for affiliation to the T.U.C. Failure to comply with this condition renders any employee liable to instant dismissal." The letter points out that the imposition upon professional engineers of compulsory trade union membership as a condition of employment has been carefully considered by the council of the Guild, which, as a result, has issued a declaration of policy as follows:—"The Engineers' Guild, Limited, an association of Chartered Civil, Mechanical and Electrical Engineers, considers that to require, as a condition of employment, that professional engineers be members of a trade union or any other organisation, apart from such as are recognised as conferring an appropriate professional qualification, constitutes an unwarrantable interference with their professional and personal freedom, and is contrary to the interests both of the engineering profession and of the public which it serves. Any attempt to impose such a condition of employment on members of the engineering profession will be resisted by the Guild by every means which it can properly employ." The Guild asks that its letter should be put before the Borough Council, and asks also for an assurance that professional engineers shall be exempt from the conditions of appointment quoted. Copies of the letter have been sent to the Minister of Transport and Minister of Local Government and Planning.

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JOINT ENGINEERING CONFERENCE

FOR many years now the three major engineering institutions of this country, the Institutions of Civil, Mechanical and Electrical Engineers, have collaborated on matters of common interest. Notably since the war they have taken the prime part in bringing into being those worldwide associations of technical institutions known as the Conference of Commonwealth Engineering Institutions and the Conference of the Engineering Societies of Western Europe and the United States of America, which have made a beginning in linking together for the common good engineers throughout "Western" civilisation. Never before, however, have those institutions collaborated in the organisation of so great a meeting of engineers as that now being held in London under the title of the Joint Engineering Conference. That Conference, which opened last Monday and will continue in being until Friday of next week, has brought together in London members from all the lands of the Commonwealth, Western Europe and the United States. It was conceived as a part of the Festival of Britain and the scope of the papers that are being presented is therefore designed in particular to show the part played by British engineers in developing the science and art of engineering during the past century. Those papers tell a splendid story.

At the opening ceremony of the Conference in the Great Hall of the Institution of Civil Engineers, last Monday, Dr. Glanville, President of that Institution, who presided, remarked that, broadly, there were in every branch of engineering the three sides, civil, mechanical and electrical, to be considered, and that without taking all three into account no balanced view could be attained. It is, in fact, impossible to comprehend the influence of engineering upon civilisation by studying civil, mechanical or electrical engineering in isolation. Each has played its part. All three are indissolubly intermingled, reacting upon each other. But, unfortunately, right though Dr. Glanville unquestionably was, it becomes increasingly more difficult as the years pass on to see engineering as a whole. Its scope has become so wide, its techniques often so abstruse, that no single mind can comprehend the whole save in the barest outline. Once it was not so. The men who, over 130 years ago, started the Institution of Civil Engineers found it possible to assume that its members could command a view of the whole of civil as opposed to military engineering. But it was not long before those who were specialising in mechanical engineering felt that their needs were inadequately met by that Institution and set up their own more specialised body. Since then increasing specialisation has led to the creation of a multiplicity of institutions and societies concerned with particular aspects of engineering, including at least one, the Institution of Electrical Engineers, which has come to command a field as wide as those commanded by the older of the major engineering institutions. But even if the scope of engineering has now become so wide that even the many papers presented before this Conference cannot pretend at all completely to cover it, it is still good that in the midst of specialisation the attention of engineers should be drawn to the interdependence of all their work; and to the enormous influence that work has had upon the development of civilisation. It is good that they should be inspired, as we think they will be inspired, to reflect upon their great responsibility to the civilisation in which they live, a civilisation which, as Mr. Stokes pointed out at the opening ceremony, they can lead to undreamed-of prosperity or to ultimate disaster.

Having seen preprints of the papers to be presented at the Conference and being aware of the eminence of their authors and of many of those who will contribute to discussions, we are convinced that this Conference will prove one of the most interesting ever held. It is therefore all the more deplorable that the attendance is no greater than it is. At the opening meeting Mr. Hartley mentioned that only slightly more than 1 per cent of the total membership of the three Institutions is participating. That is, of course, by no means so small a figure as it appears to be at first glance. For only a very small percentage of members can ever at any one time afford the expense of time and money involved by attendance. Yet it does seem to us a figure rather lower than that common at, for instance, Summer Meetings of the Institutions of Mechanical and Electrical Engineers. We wonder why? Is it that engineers as a whole are more interested in the present and the future than the past with which the papers at this Conference deal? We doubt it. For the authors of the papers surveying the past were all, obviously enough, encouraged not only to carry the story up to the present, but to hazard interesting and provocative suggestions about developments in the more immediate future. Is it not more reasonable to suppose that since the war too many conferences have been held? Certainly in the last few years there has been a multiplicity of them. No doubt, at first, they served the very useful purpose of bringing engineers up to date with knowledge that was, perforce, ineffectually spread throughout the war years. But is it not time, now, that a reversion should be made to more normal practices? Rather than ask engineers to attend lengthy conferences upon papers of sometimes doubtful value, would it not be better to allow subjects to be illuminated by the more normal method of the presentation and discussion of papers at ordinary meetings of institutions? Had there been fewer engineering conferences during the last few months to absorb the time and energy of engineers this great, interesting and inspiring "Festival" Conference organised jointly by the nation's, senior engineering institutions, would, we think, have attracted the fuller attendance that it certainly deserves.

THE GERMAN AUTOMOBILE INDUSTRY

ALL reports, so far published in the international technical press, seem to agree that the Motor Show in Frankfurt, the first of its kind in post-war Germany, revealed how great has become the capability and the vigour of the German automobile industry. There is no doubt whatsoever that this industry, having completed its rebuilding programme, is reappearing in international markets as a serious competitor to our own industry. Considering that at the end of the war the majority of German motor factories were virtually in ruins, it would be interesting to analyse in detail how the almost miraculous renaissance of the industry has been achieved. It is not sufficient to explain it simply by catch words such as foreign credits or Marshall plan aid. Those factors have certainly played some part and the Germans spent money received from abroad wisely by equipping rebuilt workshops with modern and efficient machine tools. For that purpose they were able to rely to a very large extent on the highly developed German machine tool industry. Other plant not available in Germany was imported either from Switzerland or from U.S.A. As a consequence, most of the automobile factories to-day are larger and very much better equipped than at any time before the war. But it is the men who designed and erected the new workshops, who planned

the production and, last but not least, the workmen themselves, who are actually responsible for the recovery. All industrial observers who have been watching this development with interest agree that it could not have been achieved without the intensive personal effort of everyone concerned; and we are inclined to think that it could not have been attained at all without the incentive given by free enterprise and without the sensible attitude of the German trade unions, whose leaders realised that adequate wages could only be earned by a corresponding effort so as to keep prices down as production rises. Like many other observers, we had the opportunity of visiting several factories in Germany and we were greatly impressed by the way in which workers are throwing themselves into their work. Restrictive practices are practically unknown, and the few strikes which have occurred recently have been confined to some districts in Northern Germany, where there is not only a considerable influx of new workers but also of political ideas from the Russian occupied zone.

Looking at the German motor industry as a potential competitor in the world's markets, it is worth noticing that the number of vehicles produced in 1950 was about 306,000, as against a production for 1949 of 163,000. Moreover, German manufacturers clearly have the will and the productive capacity for increasing their output. However, to judge from the statistics available for the first four months of this year, it seems doubtful whether the production figure of 1951 will show the same spectacular upward trend as those of earlier years, as the German industry is hampered in the same way as our own by the shortage of essential raw materials, in particular sheet steel, and by an insufficient supply of electric energy. But German manufacturers, free from any compulsory export quota, had until recently been rather reluctant to export their products until an efficient service organisation had been set up. Now, the building-up of such an organisation seems to be almost completed in certain areas and in some European countries, particularly Switzerland, Holland and the Scandinavian countries, German cars, especially the "Volkswagen," are already topping the import list. There are, indeed, indications that the German automobile industry intends to intensify its export drive, even if its output does not greatly increase, and great efforts are being made to regain pre-war markets and to establish new ones at almost any cost. Those efforts are likely to be successful largely because of the adverse balance which Germany has been piling up in the European Payment Union, and which is already causing serious repercussions in other countries. According to the recommendations of the Ministers of the Organisation for European Economic Co-operation, countries with a strong creditor position in the E.P.U. are to encourage large-scale imports from Germany and to restrict their exports to her. This action will allow German imports to be concentrated on Holland, Denmark, Norway, Greece and Turkey. As long as Germany's contribution to the Western rearmament programme remains in suspense, it should be easy for her to expand her markets abroad, to the disadvantage of those nations whose production is largely being diverted to defence. That remark applies not only to motor vehicles but to many other engineering products, too.

There are two classes of vehicles which the German industry is likely to export in increasing numbers and in which the British industry is vulnerable to competition. One is the small and light passenger car of less than 1 litre cylinder capacity, a class in which this country, at present, produces only one modern representative, and the other class is the heavy but fast commercial vehicle, tractor as well as truck, of more than 8 tons payload. In the first class the demand for a cheaper and lighter version of the small car, not necessarily of the orthodox family saloon, suitably reduced to scale, but of a bolder, new design, has gone up remarkably in international markets and we believe that the introduction of a similar British model would be successful. In the class of commercial vehicles German manufacturers have developed lorries of substantial weight and size, fitted with very powerful engines, and capable of speeds in excess of 50 m.p.h. If Britain is to compete successfully in European and world markets with such products should it not be earnestly studied whether home regulations, particularly those relating to the speed limit and to dimensions, should not be relaxed? For vehicles built to meet restricted conditions cannot be useful in the majority of overseas markets. Failure to bring our home regulations more nearly into line with overseas ones must necessarily affect productivity in a manufacturing industry that has made a substantial contribution to this country's exports.

Obituary

Dr. FRANCIS MAXWELL

Sugar engineers and technologists in many parts of the world will learn with deep regret of the death at his home at Selsdon Park, Sanderstead, Surrey, of Dr. Francis Maxwell, in his sixty-fifth year. He was the son of William Maxwell, who was a pioneer in engineering matters connected with the cane sugar industry. Dr. Maxwell studied at the Eidgenössisch Technische Hochschule in Zürich, after which he went on to Heidelburg University to continue his research work on the physical sciences. While at Heidelburg, in 1914, after the outbreak of war, he was interned in Ruhleben Concentration Camp for the duration of the war. In 1918 he returned to London and shortly afterwards he set up his practice as a consultant for scientific and engineering problems connected with the cane sugar industry. His practical experience and scientific knowledge bore fruit in new refining processes and the invention of the crusher-shredder associated with his name. He was widely known not only in this country, but in Australia, India, South Africa, Hawaii, Java and The Netherlands. For a time he was closely associated with the Java testing station for the cane sugar industry; he also designed and equipped several modern sugar factories in India and other places abroad. He will long be remembered by two standard treatises on "Economic Aspects of Cane Sugar Production, and Modern Milling of Sugar Cane." Dr. Maxwell was a member of the Institution of Mechanical Engineers and a Fellow of the Royal Institute of Chemistry. His death at a comparatively early age will be widely regretted by his many friends, both at home and abroad.

Literature

The Industrial Gas Turbine. By E. C. Roberson, Ph.D. London: Temple Press, Ltd., Bowling Green Lane, E.C.1. Price 8s. 6d.

This book is a readable survey of the long history of the gas turbine idea as judged largely from patent literature (not always a reliable guide). It brings the account about as nearly up to date as delay in production permits. There is a chapter on economics which is very sound but for the omission to state that, in the application to district heating, the gas turbine suffers from the high price of oil in respect of the rejected heat as well as the heat utilised. There is also a chapter on future developments. The attitude throughout is uncommonly fair in giving credit to foreign concerns, even to the point of allowing some dubious claims. The historical section might have been improved by a more critical commentary on the fallacies or the then impracticability of ideas on which the hopes were wrecked, but as the author still cherishes some of the illusions he is unable to appreciate them.

An attempt has evidently been made to avoid too great a stress on jet propulsion of aircraft. That the effort is not entirely successful will be accounted no defect since the author is clearly at his best on this familiar ground and readers would not have wished a narrower interpretation to have excluded an account of Sir Frank Whittle's spectacular success.

When the author touches on steam his mistakes are sometimes grotesque, though they clearly arise not from bias, but from uncritical acceptance of the sort of dogma which is liable to gain currency in any school which does not submit its notions for criticism by the outside world. The most deplorable mistake is the statement quoted in several places that "steam owes its low efficiency to the latent heat." In the country where the steam engine and the steam turbine were both invented, students should know that a feed heating steam cycle using unsuperheated steam takes in all its heat at the top temperature and rejects all at the bottom temperature (as latent heat), and hence, since it is also reversible, must be as efficient as any other possible cycle working between the same temperature limits. There is a general tendency to inaccuracy in detail: it is not true, for instance, that "the reaction principle is only used to-day in jet and rocket propulsion." About half of the world's steam, water and gas turbines use it, also Barker's mills at sewage works, and aircraft, whether jet or propeller types, use it, both to push themselves along and to keep themselves up. To attribute to steam turbines stage efficiencies of the order of only 60 per cent is also wrong, since efficiencies better than 90 per cent are reached in the region where the blades are neither too short nor affected by wetness.

Finally, since the book, according to the cover, is written for engineers and students, it would surely have been better to have used British units now that universities have dropped the C.H.U. Engineers also use diagrams, which convey to them more than words. Diagrams would have shortened and clarified much of the description and

would, for instance, have made clear to the reader at least why the first stage of the Holzwarth turbine was by-passed after a certain fall of pressure.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

BRITISH LOCOMOTIVES

SIR,—Let us keep a sense of proportion. Those who remember the work done forty years ago by those admirable L. and N.W. engines of the "George V" and "Prince of Wales" classes will not feel thrilled by Mr. Nock's journey from Euston to Rugby and back with a new British Railways "Pacific," I recall an occasion in 1915 when I was travelling to London in a terribly overcrowded Scotch express. Starting from Rugby, "Hermione," an engine of the "Prince" class, brought us into Euston in 91 min, with a check at Berkhamsted on the way. At Euston I walked the length of the train to add up the weights of the coaches, and I found that the train weighed 446 tons empty. Thus "Hermione" showed that she could haul seven and a half times her own weight from Rugby to Euston, start to stop, at a speed of 55 miles an hour, and it remains to be seen whether any of the much larger and more expensive engines now being built will give proportionately better performance.

There are lines in this country, notably the Highland, the Dunblane and Oban, the Somerset and Dorset, and the West Highland, which seem to call for an engine of the Garratt type, which, without infringing weight restrictions, could take the trains single-handed even at the busiest seasons and in the worst of weather, and it will be unfortunate if the wasteful practice of double-heading every important train continues to be accepted as inevitable.

W. B. THOMPSON

United University Club,
London, S.W.1,
May 26th.

VIBRATION TEST EQUIPMENT FOR TURBINE BLADES

SIR,—The comments by Mr. H. Thompson in your issue of April 20th on the writers' article "Vibration Test Equipment for Turbine Blades," were overlooked at the time of publication, but our attention having now been drawn to the letter, we apologise for making a rather belated reply. Mr. Thompson makes a number of interesting comments and suggestions which are briefly discussed below in the same sequence as used in his letter. We would point out, however, that our remarks are not in every case based on personal experimental experiences of the device considered.

As explained in the article the 2 to 1 ratio between the principal component of the impulse and the oscillator frequencies is not at all confusing in practice and is only emphasised in the written discussion in order that this fact will be clearly in the minds of any investigators who adopt this or similar apparatus for their work.

The use of a diode rectifier as suggested would be possible, but inefficient due to the added series impedance of the rectifier in the forward direction and to the loss of half of the excitation. In any event, because of the absence of pure sinusoidal impulses this additional equipment would not eliminate the need to check the relation between the measured oscillator frequency and the resonant frequency of the blade.

The proposal to use superimposed d.c. to polarise the magnet would reduce the amplitude of the a.c. which can be fed to the exciting coil before saturation of the core. There is also the additional disadvantage of the extra heating of the magnet coils by the d.c. The authors have experimented with bias adjustment of the output valve to achieve a similar effect, but have long since discarded this device for normal use.

A variable-speed motor generator set to supply variable frequency alternating current to the exciting magnet is obviously feasible, possibly up to a few hundred cycles per second.

Employing self-maintained vibration by means of a pick-up and amplifier with negative feed back control and a frequency generator to initiate vibration appears to be a rather cumbersome procedure and would probably give trouble in operation when dealing with the higher resonances, above the fundamental.

The use of a stroboscope to detect the mode of vibration visually may be possible for a few cases of long or very flexible blades where a large amplitude can be developed in the simpler modes. The method, however, is likely to have a very restricted application and with the more complicated modes appears to be quite impracticable because the amplitude of vibration is then too small to be seen.

A. GREGORY
A. M. ROBERTS

Research Department,
Metropolitan-Vickers Electrical Company, Ltd.,
Manchester,
June 1, 1951.

Newcomen Society Summer Meeting

THE summer meeting of the Newcomen Society took place on May 30th to June 2nd in Lincolnshire, the ancestral home from the twelfth century of the Newcomen family. The headquarters were at the White Hart Hotel, Boston. Quite a number of the members broke their journey at Grantham, by kind invitation of Mr. J. L. Coltman, A.M.I.Mech.E., who entertained the party to luncheon, to visit the works of the Grantham Boiler and Crank Company, to see a demonstration of the forging of wrought iron bent cranks, a technique that has become obsolete with the introduction of steel. Members also saw small vertical boilers under construction, as described by Mr. Coltman in a paper before the Society on December 20th last. A flying visit was paid to the works of Ruston and Hornsby, Ltd., under the guidance of Mr. T. B. Coltman, to see early examples of the Bisschop, Otto and Stockport gas engines and the original Hornsby-Akroyd oil engine, which we were glad to see are being preserved.

In the evening members and guests gathered at the headquarters for social intercourse and to hear a paper by Dr. S. B. Hamilton, past-president, on "John Perry (1670–1732), Civil Engineer," whose best-known work was the closing of Dagenham Breach, on the Thames, where the Ford Motor Company's works now stand. Much new matter relating to this ill-requited engineer was brought forward by the author.

On Thursday morning, by kind invitation of the Mayor and Corporation of Boston, the party was received at the Muncipal Buildings by the Town Clerk, Mr. C. T. Heffrock-Griffiths, who exhibited the borough archives, e.g., the charter of incorporation as a borough from Henry VIII, 1545, the mace and the silver oar of the former Boston Court of Admiralty. Many links with Boston, Massachusetts, were in evidence.

Departing by motor coaches or Spalding, the party visited, by invitation of Major K. Peacock, the brewery of Soames and Co., Ltd., to see an elegant table engine, 1856, and a steam hoist of the same date, both by William Tuxford and Sons, of Boston; a "National" gas engine of about 1913, with a standby "Stockport" of still earlier vintage, do the work required. Luncheon was partaken of at the White Hart Hotel. The party then divided to make interchanged visits: first, to the Spalding Gentlemen's Society's headquarters, established 1702, and the second scientific and literary institution in the kingdom. Here the honorary secretary, Mr. G. W. Bailey, F.R.S.A., showed the party MSS, incunabula, maps, pictures, ceramics, &c., but of greatest interest to those present was a MS account of Perry's fen drainage work, which, it was agreed, would be worth publication. The other half of the party went by coach to March pumping station of the Deeping Fen, Spalding and Pinchbeck Internal Drainage Board, where, by kind invitation of Mr. Edwin G. Taverner, M.S.E., the engineer, the party saw a beautifully-kept beam engine, *c.* 1833, driving a scoop wheel, which is believed to be the only such set remaining in the country. The cylinder is 25in diameter by 4½ft stroke, 30 r.p.m., driving the scoop wheel, ratio 4·06 (i.e., a lanting cog) : 1, 22ft. diameter by 5ft wide, lift 7½ft. The plant, now a standby, was shown under steam to the gratification of the party. The parties then exchanged visits and re-formed for tea.

In the evening the annual dinner of the Society was held at the headquarters in the Louise Room, and was honoured by the presence of the Mayor of Boston, Councillor J. P. Roe, J.P., and the Town Clerk. The toasts were, as usual, "The King" and "The Immortal Memory of Thomas Newcomen." The abiding purpose of the Society was emphasised by short papers or talks, illustrated by slides, on "Woad Making in Lincolnshire" and "Lincolnshire Windmills," by Rex Wailes, F.S.A., vice-president, and "Notes on the Engineering History of the Boston District," by R. H. Clark, A.M.I.Mech.E., member of Council.

On Friday morning the venue was Sibsey windmill, visited by the hearty welcome of the miller, Mr. Thomas Ward. Here, besides the six-armed mill, built in 1872, grinding grist, for there was a light wind, was seen under steam a wood-burning overtype Marshall portable engine. The next visit was to New Bolingbroke, to visit the works of Mr. J. H. Rundle. This is a typical country shop, carrying on all trades; what specially struck the party was a portable foundry cupola and staging. It was an especial treat to see a whole collection of traction engines, two of which were under steam, and members were allowed to drive them. Fortunately, no accident happened.

The district traversed afforded a sweeping view of the vast works that have been carried out since Roman times in draining this part of the Fens. After an *al fresco* lunch, the coaches were resumed and a climb of about 10 miles into the wolds brought the party to Aswardly Mill, on the River Lymm, dating from Saxon times, where the party was welcomed by the jolly miller, Harry Johnson. The present mill, the only one left in South Lincolnshire using a water wheel, is 200 years old; as usual, it was grinding grist. The water wheel is 16ft diameter by 7ft wide. The reservoir had recently been dredged from silt. Resuming the coaches, Spilsby, the home of the Franklin family and of the monument to Sir John Franklin, the Arctic explorer, were reached for tea and the party then returned to Boston, altogether a tour of upwards of 45 miles.

Those members who were able to stay till the following day had the opportunity, by the arrangement of the Town Clerk, of visiting the Boston docks, 1884, one of three municipally owned. The hydraulic power plant, 1933, electrically driven, replacing an earlier plant, steam driven, of which some portions were seen, and the new Ministry of Food wheat elevator and store were of chief interest. The weather, though chilly, was dry and sunny, and the visit was deemed by all to have been of lasting value.

BOOKS RECEIVED

Man the Maker. By R. J. Forbes. London: Constable and Co., Ltd., 10, Orange Street, W.C.2. Price 25s.

The Metropolitan Railway. By C. Baker. Surrey: The Oakwood Press, Tanglewood, South Godstone. Price 7s. 6d.

Joint Engineering Conference

No .I

A JOINT Engineering Conference of the Institutions of Civil, Mechanical and Electrical Engineers opened in London last Monday. The idea of holding such a Conference was stimulated by the project for the Festival of Britain, and the theme of the Festival has influenced the Institutions to gather together for discussion at the Conference a number of papers by eminent authors recording "the contributions to the advancement of civilisation made by the engineers and scientists of this country during the past hundred years." We intend to publish summaries of those papers and begin to do so below. Those attending the Conference besides meeting at technical sessions have a heavy programme of visits to works and of social functions in the evenings to complete. The Conference will continue until June 15th, and its meetings are being held in the halls of the three covening Institutions. It is open not only to all members of those three Institutions, but also to members of the Institutions and Societies participating in the Conference of Commonwealth Engineering Institutions and the Conference of the Engineering Societies of Western Europe and the United States of America.

At the opening session in the Great Hall of the Institution of Civil Engineers last Monday, Dr. W. H. Glanville, President of the Institution of Civil Engineers, took the chair. He expressed the sorrow of the meeting that, through ill-health, Lord Addison, Lord President of the Council, who had originally been invited to open the Conference, was unable to do so, and the pleasure of the members that his place had been taken by Mr. Stokes, Lord Privy Seal, who was a member of one of the three Institutions concerned. He went on to explain the origins of the Conference and remarked that in each branch of engineering there were the three sides, civil, mechanical and electrical, and that without consideration of all three the study of an engineering subject was not complete in itself.

Mr. Stokes, in opening the Conference, said that in organising the Conference the three major engineering institutions of this country were working together on a scale never before experienced. The Festival of Britain was being held to mark the huge march of science and invention. No more appropriate time could have been chosen to hold a Conference surveying the work of engineers. In a reference to the shortage of raw materials he said he was looking to engineers to help overcome the difficulties by finding substitutes, &c.; and he warned them that the problem of finding sufficient materials would not end when the defence programme ended. Metals would not then suddenly become plentiful. Lastly, he referred to the need to bring to Eastern and Asian peoples the advantages of Western material progress if Communism was to be defeated.

A vote of thanks to Mr. Stokes was proposed by Mr. A. C. Hartley, President of the Institution of Mechanical Engineers, and seconded by Sir Archibald J. Gill, President of the Institution of Electrical Engineers, and the meeting concluded.

Technical Sessions

Below we give summaries of some of the papers presented at the Conference. All the papers are similar in character. They trace the development of engineering, within their particular spheres up to the present day, and include the authors' opinions about the lines of development in the future.

Tuesday, June 5th

PERMANENT WAY DEVELOPMENTS IN GREAT BRITAIN

By Lieut.-Col. H. B. Everard, A.M.I.C.E.

UNDERGROUND RAILWAY PLANNING AND CONSTRUCTION

By David Anderson, M.I.C.E.

RAILWAY BRIDGES

By John S. Campbell, M.I.C.E.

In 1597 a reference is made to rails and bridges and the type of railway therein described existed in 1765, the gauge of this railway being 4ft. The Surrey Iron Railway was opened in 1803 and the tramways of Monmouthshire are of outstanding historical interest. By 1871 the most enlightened designers were producing switch and crossing work which was beginning to resemble modern practice. In 1922 the standard length of rails was generally 45ft, and later experimental lengths were rolled to 90ft and even 120ft; the decision to adopt flat-bottom rails has now been taken in Great Britain.

The total route miles covered by London underground trains is 259 miles and they are used by two million passengers a day. Generally the construction of an underground railway does not become a practical proposition until surface facilities have become inadequate to deal with the traffic. The following figures are given of the journeys per year per head of population on public transport in a number of large cities having underground railways:—Montreal, 307; Paris, 400; Chicago, 438; New York, 462; and London, 500. Underground railways provide a second plane of traffic with the highest-known capacity for handling heavy crowds. Costly though they are, they are probably cheaper than the widening of city thoroughfares, a doubtful measure of permanent relief. Skilfully planned, they can handle more than 100,000 people per rush hour in the two directions of traffic and at an average speed of from 20 to 25 m.p.h.

The majority of metal railway bridges were built between 1850 and 1890, and the maintenance of these structures is a major problem. One of the most outstanding bridges in the world is the Forth bridge, with two double cantilever spans, each of 1710ft, and two end cantilever spans, each of 675ft; this great structure was built in 1890. The Lower Zambesi bridge, opened to traffic in March, 1935, is 12,064ft long, consisting of a viaduct of 1847ft, seven spans of 165ft, thirty-three main spans of 262·5ft, and six approach spans of 66·5ft. The trusses of this bridge are very similar to those of the Hardinge bridge, India. No large-span railway bridge has been built in Great Britain since the completion of the Forth bridge in 1890, but if the occasion did arise for the building of long bridges, the use of concrete arches would be considered, and of prestressed concrete construction up to a span of 500ft, high-tensile steel being the most suitable material for spans greater than this. The Railway Executive is responsible for the maintenance of 36,710 underbridges and 25,940 overbridges, so that it can be understood why the maintenance aspect is of such tremendous importance in bridge design.

MECHANICAL ENGINEERING IN THE MERCANTILE MARINE: PAST, PRESENT AND FUTURE

By T. A. Crowe, M.I.Mech.E.

The author shows that the proportion of steam tonnage to sailing tonnage in the middle of the nineteenth century was small. In 1849 steam vessels owned in Great Britain amounted to only 170,000 tons, compared with approximately 3,000,000 tons of sailing vessels. In 1866 comparative figures were 747,000 tons of steam vessels and 4,705,000 tons of sailing vessels. It was not until after the compound engine had been generally adopted in the 1880s that steam tonnage in British ownership exceeded sailing tonnage. Before this occurred the sailing vessel remained the most economical means of carrying large cargoes for long distances. In 1858 was launched the "Great Eastern," which has been described as the most ambitious failure in the whole history of naval architecture. The enormous paddle wheels, 56ft in diameter, were fitted with thirty fixed floats, 13ft long by 3ft wide; the engines driving the paddles developed 3410 h.p. at 10¾ r.p.m., steam being supplied at 24 lb per square inch. The engines driving her 24ft diameter propeller developed 4890 h.p. at 48 r.p.m. Normal coal consumption was about 4 lb per horsepower per hour.

The reciprocating steam engine reached its zenith in the engines of the "Kaiser Wilhelm II," built in 1902. The aggregate power developed by her two engines on the twin screws was 43,000 h.p. at a steam pressure of 225 lb per square inch. The construction of these mammoth engines for this and similar ships marked the high-water mark of mechanical engineering at the turn of the century. In 1884 Sir Charles Parsons patented his reaction steam turbine, and in 1894 built the "Turbinia," the first vessel ever to be propelled by steam turbines. The centre shaft revolved at 2000 r.p.m. and each wing shaft at 2230 r.p.m. when supplied with steam at a pressure of 157 lb per square inch. With these turbines the vessel reached a speed of 34½ knots, compared with a speed of about 30 knots of the fastest reciprocating-engined destroyer of the time!

One of the most famous of the early turbine-driven Atlantic liners was the Cunard vessel, "Mauretania," built by Swan, Hunter and Wigham Richardson, Ltd., in 1906, and engined by the Wallsend Slipway and Engineering Company, Ltd. This vessel was propelled by Parsons turbines of 68,000 h.p. on four shafts. Two high-pressure turbines drove the outboard shafts and two low-pressure turbines the inboard shafts.

The author thinks that for many years to come the steam turbine is likely to remain unchallenged for the propulsion of large passenger liners, or for any vessel requiring more than 10,000 h.p. to 12,000 h.p. per shaft. In the last decade the gas turbine has made rapid advance in the air and on land, and it is only a matter of time before it is used in the Mercantile Marine. The design of a gas turbine for a merchant ship would be based more on that of industrial gas turbines than on aircraft gas turbines. In considering atomic power, Mr. Crowe points out that the fuel consumption of a nuclear reaction is about 1 gramme of radium per day for an output of 1000kW. The consumption of uranium to propel the R.M.S. "Queen Elizabeth" from Southampton to New York would be 1¼ lb! With uranium costing about £125,000 per pound, the picture does not look so bright, and Mr. Crowe thinks that it will be many years before atomic power will be used for ship propulsion.

GENERATION, TRANSMISSION AND DISTRIBUTION OF ELECTRICITY

By Sir John Hacking, M.I.E.E.

Cheap and abundant electric power is an essential part of the fabric of modern civilisation and in this vital service Britain has been a pioneer. The birth of this tremendous industry took place in 1831 at the Royal Institution, when Michael Faraday discovered the principle of electromagnetic induction and showed that electricity could be generated by mechanical means. It was not until 1882 that the public supply of electricity began with the first power station established at Holborn Viaduct, rapidly followed by other plants in New York and Milan. Against this background of early development the very advanced schemes of Dr. de Ferranti for a central power station at Deptford are remarkable. Work started in 1888, and after early troubles with cable Ferranti designed his own, for which more than

250 joints were necessary for every mile of cable. About 28 miles were laid and worked satisfactorily for many years. In 1884 Sir Charles Parsons introduced the first steam turbine for electric power generation, which ran at 18,000 r.p.m. and gave 75A at 100V; it is exhibited in London at the Science Museum. The steam turbine provided a prime mover capable of delivering great power from a small machine, and this type of drive is used on a vast scale to-day.

The author believes that during the next twenty years there will be a greater development in water power than in any other form of energy for electrical generation. At present about half the world's electricity is derived from water power, and this proportion is likely to increase, although resources are limited, and may reach full development in certain European countries within the next decade or so. Tidal power has not yet been developed on any considerable scale. It suffers from the disadvantage that it is not possible to obtain a reliable output during peak load hours without some form of energy storage system; some of the schemes which have been investigated are the Bay of Fundy scheme in the U.S.A., the Rance and St. Michel schemes in France, and the Severn barrage in England. The combination of high-temperature and high-pressure boiler with a steam-driven turbo-generator can give an overall thermal efficiency of 36 per cent, and this figure may increase within the next few years with the adoption of still higher steam conditions, but the figures achieved are approaching the maximum with present metals and the conventional heat engine cycle.

Considerable developments have taken place in gas turbines, which have the advantage for peak-load purposes that they start rapidly. Present machines are designed for oil fuel, and it is unlikely that the gas turbine will become competitive with the steam turbine in Great Britain, where oil is relatively expensive, until it can be designed to use pulverised coal. Three gas turbines for power generation are at present being installed in this country. Two have capacities of 15,000kW each and operate on an open cycle, whilst the third is a 12,500kW set, which is a combination of a closed-cycle unit with an open-cycle type of combustion circuit. Recently there has been increased interest in the use of wind power, and a special committee has been set up to investigate it. The North of Scotland Hydro-Electric Board at present has under construction a 100kW wind-driven generator to be installed in the Orkneys, whilst the British Electricity Authority are making trials with a novel design of mill employing hollow propeller blades, whose rotation induces by centrifugal force the passage of air through a turbine at ground level. The author believes that atomic energy will not play a large part for many years.

Wednesday, June 6th

THE DEVELOPMENT OF HYDRO-ELECTRIC POWER SCHEMES

By Sir William T. Halcrow, M.I.C.E., M.I.Mech.E.

POWER STATION DESIGN AND CONSTRUCTION

By V. F. Bartlett, M.I.C.E.

Water provides man's oldest source of mechanical power, and for many centuries the water mill set the pattern for the geographical location of some of the oldest industries, until the introduction of the steam engine gave a more flexible form of power and led to the vast expansion of the Industrial Revolution. Although a hydro-electric scheme with little storage can have only a low firm output, if such a scheme be connected to an electrical network which is also supplied by thermal stations, use can be made of the water which would otherwise be lost through spilling. A station with only limited storage, which by itself would be economically unattractive, might become a practical proposition if linked with thermal stations capable of meeting its seasonal deficiencies.

The need for irrigation and the immense possibilities of increasing the world's supply of foodstuffs by farming potentially fertile land has long been recognised. The demands for water for this purpose can sometimes be linked with power production and the two aims made complementary. The hydro-electric scheme can supply a regulated flow of water to be used for irrigation, which in turn leads to a thriving community and provides the market for the power. Whatever the reason for its development, water power, with its attendant possibilities of river control, will have an important rôle to play in the coming years. In the past it has been a useful adjunct to a flourishing economy; in the future it can be the driving force behind the realisation of the potentialities which the world offers to man.

The first electric generating station was constructed in a building in Holborn Viaduct in 1882, other power stations being constructed in quick succession throughout the country. To-day the civil engineering and building needs in generating stations have become fairly standard; the buildings do not vary a great deal in form or arrangement, but details of construction differ according to the ideas and propensities of the engineer and architect and the characteristics of the plant to be housed. The station normally consists of a turbine house, a boiler house and a switch house, each with special needs.

The author of the second of these two papers puts forward a very interesting design for an arched form of power station building, in which the volume of the building amounts to 70 cubic feet per kilowatt; the cost of the building, including foundations, would be about 1s. per cubic foot, or £3 5s. per kilowatt installed. This cost is claimed to compare favourably with orthodox structural steelwork and brick construction, but the main advantage would be speed of erection and freedom given to plant arrangement, alterations and renewals.

RAILWAY MECHANICAL ENGINEERING

By R. A. Riddles, M.I.Mech.E.

It is a salutary and sobering reflection that this country, with 19,600 locomotives, 56,400 carriages and over a million wagons, is just producing the first standard units for normal peacetime use throughout British Railways, and in a few years this great organisation will celebrate the 150th anniversary of the first locomotive to haul a load on rails anywhere in the world. This fact alone shows the measure of the heritage, and the length of the road that has already been covered.

In 1825, the Stockton and Darlington Railway was opened as the first public railway to employ locomotive traction. In 1829 the Rainhill locomotive trials took place, and in the following year the Liverpool and Manchester Railway was brought into use as the first public railway conveying both passengers and goods between important cities; British railway history from that time forward is well known. The very early start which British pioneer locomotive engineers gave to British export trade in locomotives must not be forgotten. Engines of Stephenson's design were supplied to France in 1828, and the first engines built in this country were supplied to America in the same year for the Delaware and Hudson line. British influence in locomotive design for many overseas countries lingered for many generations, betokening good reputation and fine craftsmanship.

In the last fifty years the pattern is one of overall progress interspersed with a wide degree of ebb and flow in all the principal developments. These advances and retreats epitomise both the strength and the weakness of the strongly individualistic approach to railway mechanical engineering which has been a feature of the different railway companies of the past. Unfettered individual effort has produced both brilliant successes and dismal failures: the former have taken our art at a single bound into new spheres of utility and efficiency. The grouping of 1923 started the breakdown of insular outlook and the 1939–45 war finished it. Just before nationalisation a high degree of exchange of technical information had been attained, and now the Railway Executive has four textbooks permanently open.

There have been many attempts in this country to improve the thermal efficiency of steam traction by departure from the basic Stephensonian locomotive. In 1910 the North British Locomotive Company made a Reid-Ramsay turbo-electric condensing locomotive, and in 1926 Beyer, Peacock and Co., Ltd., produced the Ljungstrom turbo-condensing locomotive. In 1935 a non-condensing 4–6–2 locomotive was built by the London Midland and Scottish Railway; one of the most recent advances in locomotive design, Bulleid's six-cylinder tank locomotive with sleeve valves, was made for British Railways, Southern Region, in 1949.

The main problems which this country faces to-day are concerned, as always, with reduction in cost and improved service, in addition to the saving of materials. Nationalisation has brought no sudden change either to the problems themselves or to the methods of solving them, but it has opened wide accumulated stores of railway mechanical engineering experience gathered through the years by the former companies. The heritage is a golden one, and it can never be denied that unequalled information and experience has been available.

Enterprise has always been a feature of the British rolling stock industry, to which we owe the development of the Garratt steam locomotive and of the diesel locomotive. In the latter field, private firms pioneered the design now standard for shunting work, developments for main line work being very recent.

The author concludes by stating that there are no big prizes in railway engineering, and nobody can now become rich by following it as a career. Instead, a life of unbounded interest is offered, which contains possibly that purest of joys, the beholding of the conceptions of one's thoughts made manifest. In a future abounding with possibilities, there will be more openings than in the past for qualified young engineers prepared to seize present and future opportunities.

APPLICATIONS OF ELECTRICITY TO SEA TRANSPORT

By Sir Archibald Gill, President, I.E.E.

The first use of electricity on board seagoing ships was for electric lighting, and probably the earliest installations were in warships for the operation of searchlights in about 1875, and later extended to the internal lighting of ships. The S.S. "City of Berlin" of the Bay Line had a small generator and electric lights installed in 1878, while the Cunard liner S.S. "Servia" was fitted with electric light in 1881. In 1885 the Board of Admiralty issued a general order that all mastless ships should be fitted with electric light, and from then onwards the use of electricity on board ship increased rapidly. About 1910 small turbo-generators were introduced in naval vessels and their use increased and spread to merchant shipping. The "Aquitania" was one of the early vessels to be so equipped, being fitted with four 400kW generating sets in 1911.

In 1900 a practical system of wireless telegraphy was developed for use on board ship, and this stimulated the further use of electricity, which was also applied to such purposes as the driving of fans, passenger lifts, winches, windlasses, capstans and pumps in connection with electro-hydraulic steering gear, the first example of which was installed about 1911. The first use of electric power for ship propulsion dates back to 1839, when a Russian scientist named Yakobi equipped a small boat at St. Petersburg with an electric motor fed by a battery of Grove cells. The first serious use appears to have been in submarines from 1886 onwards, while the first application to a merchant vessel was in Russia in 1903, when the shallow-draught tanker "Vandal" was equipped with three oil engines, each driving a dynamo and exciter; each dynamo normally energised a separate propulsion motor driving its own screw. Means were available, however, for interconnecting dynamos and motors. The

first British-built commercial ship to be fitted with electric propulsion was the "Wulsty Castle," completed in 1918 and fitted with steam turbo-alternators and induction motors, followed in 1921 by the fruit carrier "San Benito," equipped with a turbo-alternator driving a propulsion motor of 2500 s.h.p. Since then appreciable numbers of British ships have been equipped in this way.

Until the introduction of radio aids, navigators were able to determine their position only by astronomical observations or by taking compass bearings of fixed, visible objects. It is unlikely that for many years to come ocean-going vessels will be under continuous radio cover, while in very confined waters it may be that radio instruments will never prove to be satisfactory substitutes for local pilots. Nevertheless, radio aids are proving to be of increasing value, particularly to coasting vessels under conditions of poor visibility and in situations where the ship may be endangered by unpredictable drifts due to tidal streams, currents or wind. The saving of ship's time with radio aids will often more than cover their cost. By using radar a cable ship stationed in the inner harbour at Dover was able to leave the harbour and then proceed under guidance of the Decca navigator to a position where a fault in the cable was believed to exist. The faulty portion was identified and repaired and the ship returned to harbour all within a few hours.

(To be continued)

The Iron and Steel Institute

No. I

THE eighty-second annual general meeting of the Iron and Steel Institute was held in London on Wednesday, Thursday and Friday, May 30th and 31st, and June 1st. Mr. J. R. Menzies-Wilson, the retiring President, occupied the chair for the first part of the opening session.

The annual report of the Council for the year 1950 showed that, for the first time since 1941, there was a reduction in the number of members. The total at December 31, 1950, was 4882, compared with 4909 at December 31, 1949. The report attributes this reduction entirely to the smaller numbers of associate members (702, instead of 857 a year ago) and especially of associate members who are resident in the United Kingdom, and are members also of the Institute of Metals or of the Institution of Metallurgists (a reduction from 516 to 399). The number of associate members living overseas hardly changed (80 instead of 83). The number of ordinary and life members increased from 4025 to 4149, and at the end of the year was greater than on any previous occasion, the increase being evenly divided between the home and overseas membership (61 home, 63 overseas). During the year, 333 ordinary and associate members were newly elected or reinstated. The deaths of 45 were reported; 225 resigned, 73 were struck off the roll of members, and 17 elections lapsed for non-payment of the subscriptions due.

The financial statement showed income at £58,500, which was £3250 higher than in the previous year, and expenditure at £52,600, which was £800 less, resulting in a surplus of £5898, which was £4000 greater than in 1949. This satisfactory result, the President said, was largely due to the income from subscriptions, which again increased (£16,300, as against £15,900), and to the substantial sum which it had been possible to transfer to the general account from the publications account.

Awards

The President announced the award of the Bessemer Medal for 1951 to Mr. Benjamin Fairless, President of the United States Steel Corporation, in recognition of his distinguished service to the iron and steel industry. Mr. Fairless was unfortunately unable to be present at the meeting, but the presentation was made last week in the U.S.A. by Sir Charles Goodeve, who is leading the iron and steel productivity team.

The President then made the following presentations:—The Sir Robert Hadfield Medal, to Mr. W. Barr, of Colvilles, Ltd., in recognition of his contributions to research in steelmaking; the Carnegie Silver Medal for 1950, to Mr. A. B. Winterbottom, of the Technical University of Norway, Trondheim, for his paper on "Optical Studies of the Oxidation of Iron at Temperatures in the Range 20-265 deg. Cent."; the Williams Prize for 1950, to Mr. T. H. Harris (Brymbo Steel Works, Ltd.) and Mr. W. H. Everard (Edgar Allen and Co., Ltd.), for their paper, written jointly with Mr. D. J. O. Brandt, on "The Use of the Oxygen Lance in British Electric Furnace Practice," with a special prize to Mr. Brandt in recognition of his share in the work; the Ablett Prize for 1950, to Mr. D. A. Wise and Dr. L. N. Bramley, both of B.I.S.R.A., for their paper on "Proposed Method of Specifying Travel-Motion Performance for Steel Works' Overhead Cranes."

After announcements concerning changes in the Council and future meetings, Mr. Menzies-Wilson vacated the chair and inducted into it the new President, Mr. Richard Mather.

Presidential Address

Upon taking the chair, Mr. Mather proposed thanks to his predecessor, and then proceeded to deliver his Presidential Address, entitled "The Iron and Steel Institute and Industry." The Address dealt mainly with the establishment, growth and work of the Institute, and its relationship with the iron and steel industry. Concluding it, the President said:—"The outcome of all this growth has been that the Institute is now largely in the hands of practitioners in the industry who have specialised in one or more of its many branches of activity and inquiry. Those whom I may call the 'industrialist' members of the industry, whose main occupation is to keep its operating units functioning and to balance its various needs and possibilities and keep them within the bounds of what is feasible, are relatively fewer in number than they were many years ago. Nevertheless, the Institute presents both in its membership and in its many activities a well-balanced field of work for all who are interested in the fundamental well-being of the industry. I have tried to set out the relationship between the Institute at the time of its formation and the industry at that time, and to indicate such gradual changes in that relationship as developed in the intervening years.

"If the consolidation into one ownership of so preponderant a part of British industry had followed the lines of some of the other measures of nationalisation, I should frankly be apprehensive of its effect on the vigour and future possibilities for good of this Institute. I have tried to show that the work of the Institute has been essentially that of individuals who were free to pose their problems, state their views, and, if they thought right, to criticise the views of others, on the many matters connected with the development of the industry that came within the purview of the Institute. I believe that this freedom of discussion and criticism has been a valuable element in the progress of the industry. Neither the industry nor the Institute has, at any time, attempted to lay down any definite, official or final pronouncement on any of the many questions which have arisen. There has always been ample scope for the expression of views by the man who does not accept what might seem to be the prevailing view at the time on any debatable subject. The organisations of the Institute and of the industry have not been such as to put any difficulties in the way of such a man. I feel that this freedom has been of great benefit.

"If the recent reorganisation of the British steel industry endures, it will be advisable for all of us to be more vigilant than has been necessary in the past to ensure that we remain free from any restrictions (more particularly, perhaps, indirect restrictions) of our practice of full discussion of any of the technical matters which come within the scope of the Institute. The new form of organisation of the industry is not such as immediately to cause as much apprehension on this matter as would have arisen under other forms of organisation. However, administrative practices can, in the long run, be of more influence than the nominal form of an organisation. These practices may, without any deliberate intention on the part of the administrators, and perhaps almost without recognition of their early effects, result in some loss of technical freedom by the individual. He may gradually find himself with fewer opportunities to express his views or to advance new ideas, whether through the medium of the Institute or otherwise.

"I wish to close, therefore, on this note: the future well being of the industry will depend, as its past successes have depended, on the freest access to open discussion, on criticism of existing practices, and on the production of new ideas and their testing in practice. The members of this Institute, in their duty to their industry, must constantly ensure that these fruitful methods of its further growth remain available to themselves and to their successors."

A vote of thanks to the President was moved by Mr. T. M. Service, and was followed by a paper entitled:

THE PRESENT POSITION OF THE CONVERTER PROCESS.

BY DR. MONT. ING. BERNHARD MATUSCHKA.

Synopsis

A comparison is made between the economic aspects of open-hearth and basic Bessemer steel production. It is shown that when slag is recovered the ingot costs for the two processes are about equal, provided that the open-hearth plant can work with 50 per cent of scrap; for a works producing one-third basic Bessemer steel and two-thirds open-hearth steel, the costs are lower than for an entirely open-hearth works, if equal amounts of scrap are available.

Costs for blowing stahleisen are higher than those for an open-hearth plant, but in a works combining converters and open-hearth furnaces the total costs are about the same as for entirely open-hearth operation; when oxygen is used for blowing, a steel is obtained whose quality is equivalent to that of open-hearth steel, but at a price 5 to 10 per cent higher. Steel made in an induction-heated converter would be as cheap as open-hearth steel, if the charge carried 50 per cent of scrap.

The oxygen-blowing process and the induction-heated converter enable a great part of the manganese content of pig iron to be converted into a

slag suitable for the preparation of ferro-manganese low in phosphorus, and offer the possibility of providing a large part of the ferro-manganese needs of Europe.

Discussion

Mr. D. F. Campbell (Electric Furnace Company, Ltd.): The first problem with which we are all faced at the moment is the shortage of scrap, and to some extent the shortage of iron ores; and, as we are bound to look for new ore fields from time to time, we have to reconsider the steelmaking methods suitable for those ore fields. The basic Bessemer process, which was born in this country, has been widely used all over the Continent. A serious difficulty was created a year or two ago by the introduction of strip mills, because with the widening of flat products and the demand for flat products it is obvious that it is not possible to produce the quality of strip required at the right price except in strip mills, and that necessitates having good steel.

I hope that this discussion will give us more definite information on whether basic Bessemer steel is to be improved by blowing with oxygen, or oxygen and steam, or oxygen and CO_2, or by the Perrin process, or what is to be done so as to make more iron ores available for steelmaking and more steel available for strip mill work and deep pressing. It is obvious that in the next ten years there has to be a great deal more smelting of iron ores and less dependence on the melting of scrap.

Dr.-Ing. R. Durrer (Switzerland): The possibility of utilising oxygen for oxidising pig iron is one which has been discussed very often in recent years. The work which has been done in utilising oxygen to convert pig iron into steel has shown that the difficulties are fairly small. In a small Swiss iron plant tests have been carried out in a converter of about 2½ tons. The work has been done on an acid basis and on a basic basis. At first, of course, there were difficulties, but they have been overcome completely. There has not been the possibility of increasing the size of the converter, but work has been carried out with bigger iron plants.

The tests which have been carried out in Austria have been done with pig iron which was low in phosphorus. If phosphoric pig iron is blown there are more difficulties, because of the fact that towards the end of the process the bath is "dead." In the small converter of 2½ tons to which I have referred these difficulties have been overcome, but in bigger converters they still exist.

Another question relating to the Bessemer process is how the quality of the steel compares with the steel produced in the open-hearth process. The principal disadvantage in this respect of the Bessemer steel, both acid and basic, is the fact that the nitrogen content is higher than the nitrogen content of the open-hearth steel. I think, however, that in using oxygen this disadvantage of the Bessemer converter as compared with the open-hearth furnace is changed into an advantage, because when using oxygen at a sufficiently high concentration the nitrogen content of the finished steel is lower than that of the open-hearth steel. Another question which must be discussed is that of the regeneration of the scrap. As we all know, the principal task of the open-hearth furnace is to regenerate the scrap. We could not do that in the past in the converter, because the possibility of regenerating scrap in the converter is too small compared with the bulk production of scrap; but by eliminating the nitrogen we save so much heat that, roughly speaking, about half the weight of the pig iron blown into steel may be melted in the form of scrap with the heat which is saved in this way. If we assume that the whole of the pig iron of the world, with the exception of that used for foundry purposes, is converted into steel with the help of oxygen, then we shall be able to melt about 50 to 60 million tons of scrap. As far as I know, the consumption of scrap in the whole world last year for the production of steel was between 80 and 90 million tons, so that when we think of 50 to 60 million tons of scrap being regenerated in converters operated with oxygen it will be seen that the percentage of the total scrap is rather high, and that the greatest part of the task carried out up to now by the open-hearth furnace could be taken over by the converter.

On the other hand, these reflections are based only on the fact that we use ordinary pig iron, but I think that in the future we have to learn to look on pig iron, to a greater extent than we do at present, not as a finished iron, but merely, in so far as it is not used for foundry purposes, as an intermediate product, the analysis of which is not important if we are able to change our smelting processes. Up to now we have produced about 99 per cent of our pig iron in the blast-furnace, and the operation of the blast-furnace limits the possibilities very much with regard to iron ores, to the reducing materials and to the finished product. After having changed this blast-furnace process—it will not be done in the next few years, but in the next few decades—I am convinced that we shall have no difficulties in smelting iron ores arising from their composition, and I am thinking especially in this respect of the higher content of silicon.

It is well known that there are enormous quantities of iron-containing minerals in the world which to-day are not called iron ores, because we cannot, owing to technical and economic difficulties, smelt them in the blast-furnace; but, after having replaced the blast-furnace by a more elastic furnace—let us say a furnace with a better stomach—these limits will be eliminated or extended, and we shall be able to smelt iron ores with very high contents of silicon and with low-grade carbon. In doing this we shall get an intermediate product replacing the pig iron of to-day, with a much higher content of silicon, and then, in converting this intermediate product into steel, we shall get much more heat than with the pig iron of to-day, and we shall be able to regenerate a greater quantity of scrap iron than the 50 to 60 million tons to which I referred earlier.

Dir. Dipl.-Ing. T. Suess (United Austrian Iron and Steel Works, Linz): This paper affords me the opportunity to give some information about some investigations which Austrian metallurgists have successfully concluded during the past year. The question of refining pig iron with a manganese content of 2–2½ per cent and a phosphorus content of about 0·1 per cent, and sometimes a little lower or a little higher, has occupied Austrian metallurgists for a long time. After several extensive investigations on the blowing of basic iron in a basic converter, we started in May, 1949, at Linz, the process of refining by the blowing of pure oxygen on the surface of molten pig iron in a vessel similar to a Bessemer converter. The development of this process has now passed beyond the experimental stage; several thousands of tons of steel of different qualities have been produced, so that the complete results of the process can now be definitely stated.

In particular, it can be definitely stated that the metallurgical process has been completely mastered, and methods have been developed whereby any required steel quality can be produced with certainty. The properties of the steel produced by this method are very satisfactory; they correspond to those of open-hearth steel and they are in some ways even superior to those of open-hearth steel. The analysis of the pig iron used can range within very wide limits, and the temperature of the blown iron has no great influence on the process. The oxygen consumed per ton of pig iron is round about 60 cubic metres. The life of the nozzle as well as of the refractory lining is satisfactory, and corresponds to that normally obtained in an ordinary Bessemer converter.

The Austrian metallurgists had to decide which process should be chosen for refining the pig iron, especially as, according to the Austrian iron and steel plan, a wider expansion of steel production capacity was necessary. It was possible to make an economic comparison between the open-hearth process and the new oxygen-blowing process as a result of the practice at Donawitz and Linz, and not based on any theoretical considerations. The result of this comparison was that by assuming the same percentage of pig iron and scrap in the open-hearth and in this process, namely, 70 per cent pig iron and 30 per cent scrap, the production costs of the oxygen-blown steel are remarkably lower than the production costs of open-hearth steel. Under Austrian conditions, even with 50 per cent pig iron and 50 per cent scrap, the production costs of open-hearth steel are higher than those of oxygen-blown steel. Furthermore, the capital costs for the oxygen process, including the oxygen plant, are considerably lower than for any open-hearth steel plant of the same capacity. It may be said that even steel works of comparatively low capacity operating the oxygen-blowing process will cost less than 60 per cent of straight open-hearth steel works of the same capacity, and the smaller area needed for this process has also to be considered. The management of the Austrian steel works in Linz and Donawitz decided, therefore, to base their extension of steel capacity on this process, and no open-hearth furnace will therefore be erected in Austria in the coming years.

Mr. W. L. Kerlie (Stewarts and Lloyds, Ltd., Corby): When I first read this paper and examined the tables on page 42 I was inclined to the opinion that some of the figures required considerable alteration in order to come into line with the facts; but after a closer study of the problem as set out by the author, and particularly after comparing the data with those from other sources, I soon came to realise that the comparison of the open-hearth and basic Bessemer processes appeared to be based on reliable data and careful work. The author mentions in his conclusions that, if the price of scrap is about two-thirds that of pig iron, the ingot cost for a basic Bessemer works is about equal to that for a modern open-hearth plant working with 50 per cent of pig iron. Perhaps I should point out that, for iron-making, if the scrap price falls below two-thirds of the normal iron cost using ore, it becomes economically advantageous to use a large amount of scrap in the blast-furnace. One would expect, therefore, that the "natural" value of scrap in any given locality would be two-thirds of the iron cost, using an essentially ore burden, and in a locality where ore is easily won and freightage costs for scrap are high it will be economically sound to concentrate on smelting as far as possible with ore, operating mainly on the basic Bessemer process for steelmaking and using the open-hearth process for the economic balance of uprising scrap.

(To be continued)

A Rail Traction Diesel-Electric Unit

LAST week we visited the works of Davey Paxman and Co., Ltd., at Colchester, to see the first of a new series of oil engines, which the company has developed for rail traction purposes. These engines, to be known as the "YL" series," have a compact vee-cylinder arrangement and are available with eight, twelve or sixteen cylinders, in horsepowers ranging from 533 to 2000. They are particularly designed for use with B.T.H. electrical traction equipment on the larger classes of heavy duty diesel-electric locomotives and the various types of engines made in the series and their ratings are shown in the table on this page. The compact design, which has been developed, and the constructional details of the new engines can be seen in the photographs and drawings reproduced of one of the twelve-cylinder, 1500 b.h.p., pressure-charged units.

The engines have a bore of 9¾in by 10½in stroke and the vee cylinders are arranged at 45 deg., the crank angles for the different models being as follows: eight cylinders, 180 deg; twelve cylinders, 120 deg., and sixteen cylinders, 90 deg.

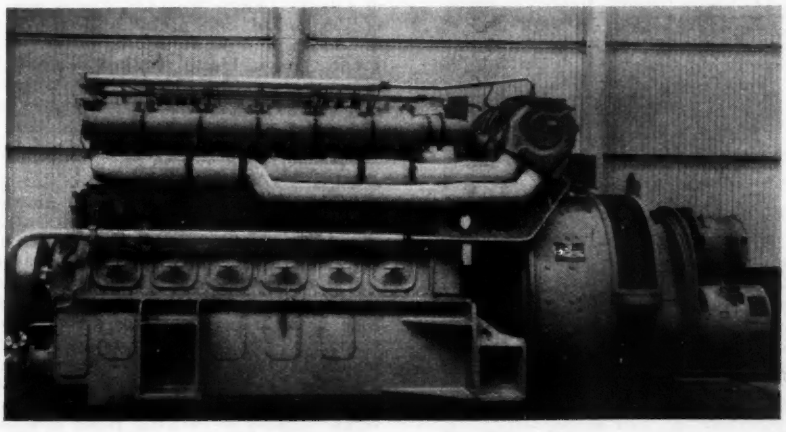
The fabricated steel plate main structural members of the frame and bedplate are fully stress-relieved before machining and are well reinforced. To the bedplate, which also forms a lubricating oil sump of 180 gallons capacity, are welded steel stampings used to carry the crankshaft main bearing housings. The frame, which is mounted in the bedplate, on a heavy flange, at crankshaft level, houses the water jackets for the cylinder liners and carries the individual cylinder heads. A four-point mounting system is designed to give a reasonable load distribution of the engine without imposing undue stress on the bedplate as a result of locomotive frame flexure. The feet, which are carried in semi-resilient pads, are formed integral with the bed at the free end and with the lower section of the generator attachment member at the driving end of the engine.

The crankshaft, a heat-treated alloy-steel forging with solid crankpins and journals, is fitted with balance weights. The steel-backed, copper lead-lined main bearings are lead-plated to assist running in of the engine and fork and blade big-end bearings are fitted with replaceable copper-lead shell bearings. The connecting-rods are fully machined steel stampings drilled for small-end lubrication and accurately matched for balance. The forked rod carries the big-end block, which is secured by four bolts, the mating faces of both bearing housings being located by serrations. Large doors give free access to the interior of the crankcase and through them the piston and connecting-rod assemblies can be passed without need for removing the cylinder heads.

The pistons are of aluminium alloy, with four compression and two oil control rings and have fully floating gudgeon pins with phosphor-bronze small-end bushes pressed into the connecting-rod eyes. The cylinder liners of centrifugally cast iron have chromium-plated bores and are carried in individual water jackets of galvanised steel. A cylinder-head plate is fitted on to the upper flanges of the cylinder liners with an intervening copper ring joint and in this plate the cast iron cylinder heads are secured by means of studs. In each head there are four valves with a centrally placed injector. These valves are operated by overhead rockers incorporating a parallel motion mechanism.

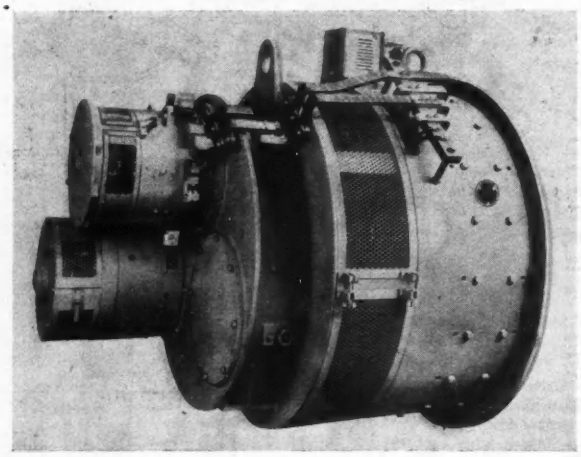
Engine Ratings

Type of engine		8YL		Pressure-charged 8YLX		12YL		Pressure-charged 12YLX		Pressure-charged 16YLX	
Maximum rating	Engine speed (r.p.m.)	B.h.p.	B.m.e.p. (lb/in²)	B.h.p.	B.m.e.p. (lb/in²)	B.h.p.	B.m.e.p. (lb/in²)	B.h.p.	B.m.e.p. (lb/in²)	B.h.p.	B.m.e.p. (lb/in²)
Twelve-hour	750	533	90	750	126	800	90	1125	126	1500	126
Intermittent	750	586	99	825	138·5	880	99	1238	138·5	1650	138·5
Twelve-hour	900	580	81·5	850	119	870	81·5	1275	119	1700	119
Intermittent	900	638	90	935	130·9	966	90	1400	130·9	1870	130·9
Intermittent	1000	710	90	1000	126	1070	90	1500	126	2000	126



DIESEL-ELECTRIC UNIT

Two camshafts are housed, one above the other, in the vee between the banks of cylinders. The lower camshaft, which operates the valve gear, is driven by duplex chain from the drive end of the crankshaft and it has two cams for each cylinder. The upper camshaft operates the individual fuel injection pumps for each cylinder and it is driven from the lower camshaft through helical spur gearing. Each of the camshafts is carried on bearings fitted with steel-backed, white-metal lined, shells. The cam followers consist of hardened steel rollers fitted to rockers for the valve gear and vertical tappets for the injection pumps. Individual C.A.V. injection pumps supply fuel to multi-hole injectors used on the engine.



MAIN GENERATOR WITH EXCITER AND AUXILIARY GENERATOR

A hydraulic servo governor fitted to the engine is driven from the camshaft and employs engine lubricating oil as the working fluid. A gear pump, driven from the free end of the crankshaft, feeds lubricating oil to the engine, lubricant being fed to the crankshaft bearings at 50 lb per square inch and, through a reducing valve, at 10 lb per square inch, to the camshaft and valve gear.

At the driving end of the engine there are mounted twin exhaust-driven Buchi turbo-blowers, which are designed to enable an output 42½ per cent above the normally operated aspirated rating to be developed. Cooling water is circulated through the engine by twin centrifugal pumps driven through gearing from the crankshaft.

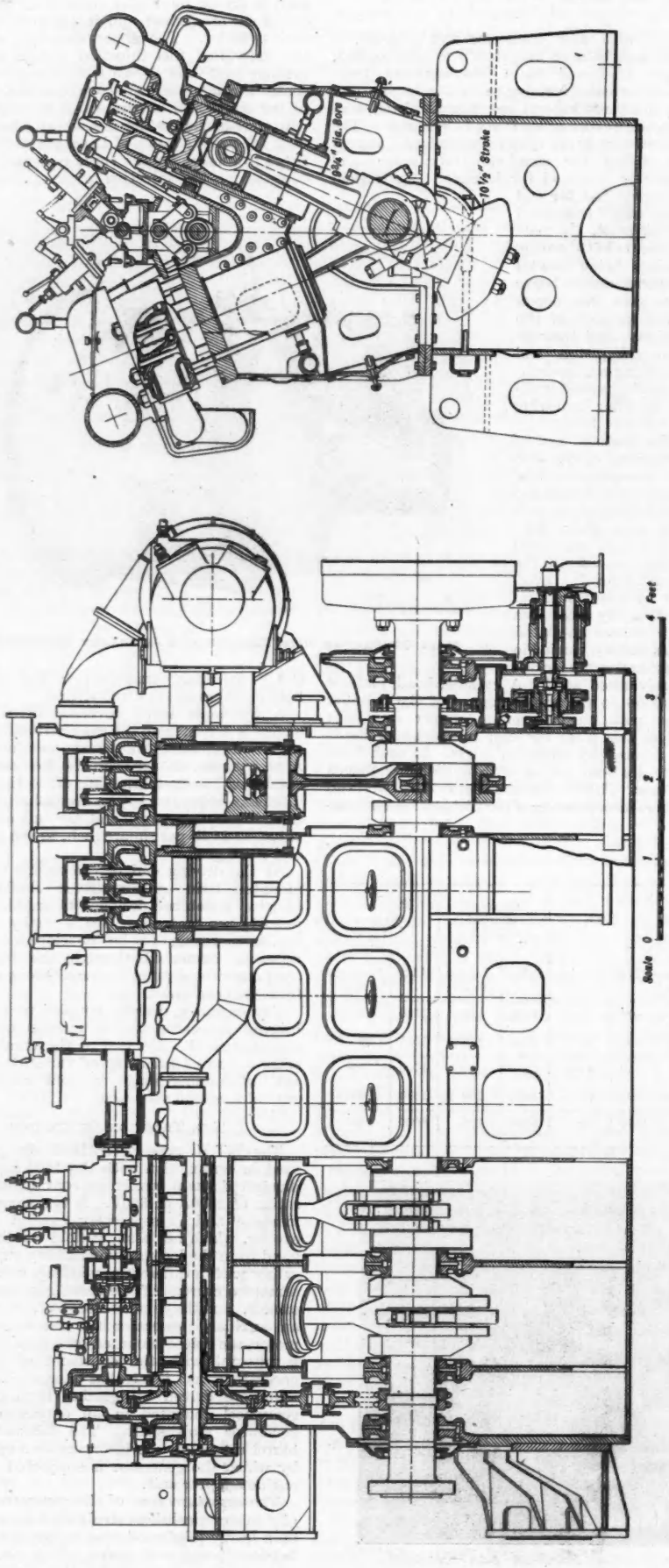
The engine is directly coupled to the single bearing generator and a viscous damper is mounted at the free end of the crankshaft in order to permit infinite speed variation throughout its running range without incidence of critical torsional vibration.

The Traction Generator

The B.T.H. type R.T.B.16848 d.c. generator used in conjunction with the 1500 h.p. engine illustrated has a maximum continuous current rating of 2200A at 850V. It is a shunt wound machine and is separately excited from an exciter, which has a shunt field winding (energised from the locomotive auxiliary supply), together with a differential winding, carrying the armature current of the main generator. The exciter, auxiliary generator and, if required, an auxiliary generator for the radiator fan motor, are spigot mounted on a gearbox, which is integral with the endshield of the main generator, as illustrated herewith. These units are driven by gearing from a central gearwheel mounted in an extension of the generator stub shaft. The fabricated steel barrel magnet frame incorporates a spigot ring by which the generator is supported from the engine adaptor unit.

The armature core of the generator consists of thin electrical sheet steel punchings, mounted on a heavy fabricated steel spider and clamped between heavy end plates, which also provide a continuous support for the end windings.

TWELVE CYLINDER OIL ENGINE FOR RAIL TRACTION



The hollow cylindrical fabricated spider is fitted with a stub shaft at the non-drive end and at the opposite end it is connected to the engine coupling spigot through a solid steel disc. This disc is designed to offer the maximum resistance to torsion and transmit the drive to the largest diameter of the spider.

A heavy fabricated steel fan on the generator draws in cooling air at the commutator end and distributes it over the armature and field coils and through ducts in the core. The former wound coils of the armature winding are assembled in open slots in the periphery of the core and held in place by wedges of bonded material dovetailed into grooves at the top of the slots. Binding bands hold the end windings of the coils, which are insulated with mica, glass and asbestos only. All connections in the coils are brazed to ensure satisfactory operation under very heavy overload conditions, and equalising connections are provided.

The main generator embodies a "Pollock" commutator, in which steel bars with bulbous-shaped tops, are keyed with corresponding recesses in the copper segments. The steel bars are welded to a number of steel rings, the whole assembly being retained on a steel shell. The hard-drawn copper commutator segments are supported along nearly their whole length by the steel bars and the micanite insulation between them is slightly undercut.

A rigid fabricated steel brush yoke mounted on the frame end plate carries metal brackets, on which the brush boxes are supported. The brushes are split and have their effective widths equally divided. Pressure is applied to each brush by a rigid arm fitted with an insulated roller running on a metal cap secured to the brush in such a way that the arm cannot carry current from the top of the brush.

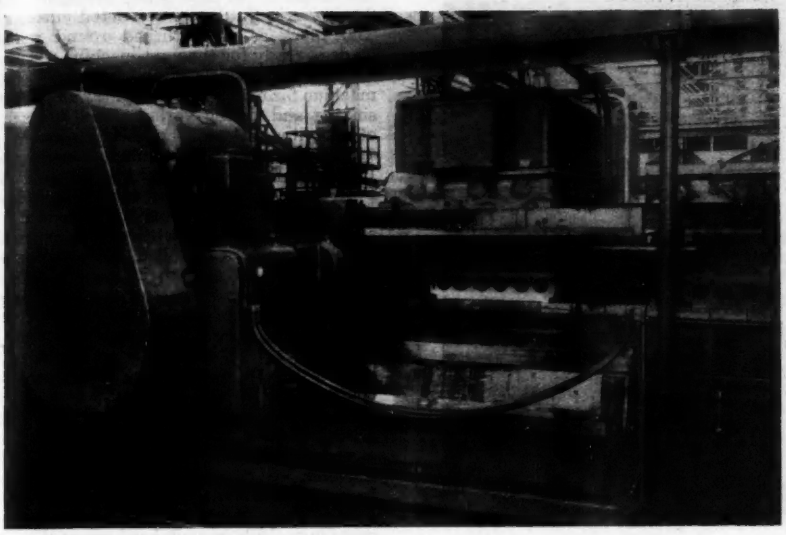
A torque control regulator mounted on the power unit consists of a hydraulically-operated rheostat, the movement of which is regulated by a torque control valve linked to the engine governor. The torque control valve incorporates two moving elements, provided with ports, through which a hydraulic motor driving the rheostat is operated. The valve is linked to the engine fuel rack and the governor speed setting levers respectively. When a change of external load causes the engine governor to change its position the relative positions of the torque control valve elements are affected and the ports feeding pressure fluid to the hydraulic motor of the rheostat are uncovered. The motor then rotates the rheostat in the direction necessary to adjust the electrical load until it is equal to the rated engine output. The actuating fluid used in the torque regulator is supplied from the engine lubricating system.

Construction of Large Transatlantic Passenger Vessels

PLANS for the construction of two large single class transatlantic passenger vessels were presented for approval to the Federal Maritime Board recently by Paul W. Chapman, president of Liberty Liners, Inc., and former president of the United States Lines. The tentative dimensions of these ships are: overall length, 1254ft; beam, 144ft; depth, 103ft, and draft at normal load, 38ft. The ships are intended to be capable of a sustained sea speed of 34 knots, and are to have four propellers driven by double-reduction geared turbines with a total of 280,000 s.h.p. Both ships are designed essentially to make possible a fortnight's holiday in Europe for middle-class Americans, and each will have accommodation for about 9000 passengers and a crew of 1600. All living and public spaces for passengers and the crew will be air conditioned. It has been estimated that at least 20,000 troops could be carried in each vessel if used as transports in time of emergency. Steam will be supplied by eight boilers operating at 925 lb per square inch and 1000 deg. Fah. total temperature at the superheater outlet. Each vessel will have a dry cargo capacity of 375,000 cubic feet and a refrigerated storage capacity of 100,000 cubic feet.

Cylinder Block Production at Dagenham

IT will be recalled that at the International Motor Show, last year, the Ford Motor Co., Ltd., Dagenham, introduced a series of cars of completely new design, which at present consists of the "Consul," which has a four-cylinder engine, developing 47 b.h.p. at 4400 r.p.m., torque 74 lb per foot at 2400 r.p.m., and the "Zephyr Six," a slightly longer car, with a six-cylinder engine, developing 68 b.h.p. at 4000 r.p.m. and a torque of 112 lb per foot at 2000 r.p.m. These cars are now in quantity production, although the "Consul" enjoys a much greater priority, and a production line of considerable interest has been installed. As a primary objective the company has attempted to eliminate from the machining cycle all manual handling and manipulation of the major engine components. In effect the production line associated with a particular component is equipped with multi-travelling head autos specifically designed to accommodate "Consul" or "Zephyr" engine components and by a series of electrical/mechanical/hydraulic sequences assisted by extensive synchronous interlocking, the component proceeds automatically through the separate stations on each machine and from one machine to another. With no production line does this continuity exist entirely unbroken, but the extent to which this so-called "process" system has been realised is best illustrated in the production of the cylinder blocks. The cylinder block lends itself particularly to this treatment and its production provided the main interest during a recent visit to the Dagenham works.



NINE STATION TRAVELLING MILLING MACHINE

The "Consul" has a four-cylinder block, cast integrally with the upper half of the crankcase and is identical in several respects to the "Zephyr" six-cylinders block. Both engines have the same bore (3·125in) and stroke (3in), with a compression ratio of 6·8 : 1. Other leading dimensions have been arranged common from one end, or a location point, so that it might be possible to route both engine blocks through the same machines with little or no modification to the automatic cyclng.

A continuous overhead chain conveyor, which circuits much of the plant, carries the different components as cast from the foundry, and from this conveyor the cylinder blocks are taken as required.

The cylinder block casting has four pads incorporated on the valve side and these are machined to determine a location for the first milling operation. These pads are milled on a Cincinnati two-spindle ram travelling head milling machine, which has a fixture mounted on the table to locate the casting from four points on the inner edge of the bottom flange, two cored holes in the top face and two points on the top face of the bottom flange for vertical position. The travelling head has two cutter spindles with individual eccentric quill adjustment.

Once placed in this fixture, the casting is automatically located, clamped, milled and unclamped. The machine has a capacity of 50 blocks per hour.

The cutter spindles carry two 3in diameter inserted blade carbide cutters with a peripheral speed of 220ft per minute and a feed of 20in per minute. Having established these location pads, the block slides to an Ingersoll nine-station process milling, drilling and reaming machine, which is perhaps the most advanced milling machine to have been constructed. This piece of equipment is 54ft long, weighs approximately 90 tons and is powered by thirteen motors, developing a total of 170 h.p. Owing to its length, it has been difficult to obtain a photograph of the entire machine in situ and an illustration shows the last travelling milling head after the completion of the finishing cut on the cylinder head face.

The machine is arranged to carry out the following operations :—

Station 1.—Turn cylinder block from previous operation through 90 deg. so that the water jacket side is uppermost, front end leading.

Station 2.—Rough-mill top face.

Station 3.—Rough-mill bottom face.

Station 4.—Rough-mill bearing cap and cap seats.

Station 5.—Finish-mill bottom face and cap seats.

Station 6.—Shave bearing locks.

Station 7.—Semi-finish-mill top face, leaving 0·025in for finishing.

Station 8.—Drill, chamfer and ream two 0·5615in to 0·5625in holes for location in bottom face.

Station 9.—Mechanically turn cylinder block through 90 deg. to head-face up.

The six milling stations consist of a bed carrying four milling heads and hydraulically operated fixtures to hold one cylinder block at each station of either the four or six-cylinder type. The arrangement of the milling heads is as follows :—

Station 2.—Single spindle head.

Stations 3 and 4.—Five-spindle head.

Stations 5 and 6.—Two-spindle milling head with shaving attachment.

Station 7.—Six-spindle head.

The drilling and reaming unit consists of a six-spindle head having longitudinal indexing between two positions, first presenting the drilling spindles to the working position and then shuttling the reaming spindles to complete the operation. The locations used in these processes are the milled pads, which were created in the first operation. The peripheral speed of the milling cutters for the large face is 200ft per minute for roughing and 500ft per minute for finishing and the rate of feed 50in per minute.

With a cylinder block in each station and the starting button having been pressed, the automatic sequence is initiated. In succession the blocks are hydraulically clamped in position, the milling heads feed through the cut, clamps are released and the milling head is returned to start position, at the same time transferring each block forward one station and repeating the previous cycle after a further cylinder block has been slid into station 1. Once the sequence has been started the operator has no other function on this machine.

The blocks are received from the foundry in an undressed condition, the "flash" lines being chilled and the surfaces to be machined containing quite an amount of abrasives from

NINE STATION DRILLING REAMING AND TAPPING MACHINE

the casting operations. Blocks produced by the machine at a rate of fifty per hour at 100 per cent efficiency.

The pan rail face now being flat and the dowel holes drilled and reamed, these datum points are now used for most other subsequent location purposes.

The block having been indexed at station 9, as mentioned, is then transferred to a Sunstrand duplex travelling head four-station process milling machine. Briefly the machine consists of a welded steel base with hardened and ground steel stripways on each side, on which slide the two milling heads. The centre

SEVEN-STATION DRILLING AND TAPPING MACHINE

section of the base serves to carry the locating fixture and the transfer rails and at a position above the fixture a cast iron housing incorporates the hydraulic clamping mechanism. The process undertaken by this machine is to rough and finish-mill both ends of the block. The right-hand head carries one roughing and one finishing cutter of 12in diameter at a peripheral speed of 250ft per minute for roughing and 300ft per minute for finishing and the left-hand head operates two 14in diameter cutters in the same sequence and at the same speed. The feed employed is 50in per minute, which gives an output of fifty blocks per hour at 100 per cent efficiency.

The casting is accepted from the previous machine on to two rails, on which are mounted pick-up fingers. These fingers engage the block on the outside edge of the pan rail face and in operation are hydraulically traversed, carrying the block to the locating fixture. The fixture is fitted with two dowel locators and when the block is in position the transfer rails lower the cylinder block down on to fixture location pads. The hydraulic clamping cylinders push the clamping pads on to the cylinder head face and then the milling heads set apart by a "Consul" cylinder block length, are tripped into operation. When a "Zephyr" block is placed in the machine and the cutters have traversed the front end face, a hydraulic pusher moves the block over a distance corresponding to the difference in length between the two blocks for the opposite cutter head to mill the flywheel housing face.

At the end of the cutting cycle the block is unclamped, the transfer rails lift the block from the fixture and the transfer bar shuttles the block to the next machine. This is an Archdale No. 5 snout borer and is used for rough boring the cylinder bores. The machine is fully automatic and arranged to cater for both four and six-cylinder blocks. The arrangement of standardisation of dimensions from an agreed point was absolutely vital in planning for both blocks be be routed through the same machines.

The feed is 8in per minute and speed 160ft per minute. The component is then passed to another Archdale No. 5 snout borer for semi-finish boring and is substantially a duplicate of the previous machine.

The next operation is the milling of the starter motor pad and for this operation a Newton horizontal travelling head milling machine is used. This is a single-station transfer machine, in which the transfer bar pulls the block into the fixture, the dowel pins enter the reamed holes in the pan rail face, and the direct-acting hydraulic clamps lock the block in position. The milling head carrying a 12in diameter cutter is set at right-angles to the bed of the machine and automatically fast traverses, mills the starter pad and returns to the starting position.

The block is then transferred manually to a Kearney and Trocker travelling head milling machine to mill the push rod cover face. The mechanical transfer of the block into and out of this machine is the same in principle as on the Newton miller. Due to obstructions at each end of the casting it is not possible to feed the cutter in a continuous longitudinal path.

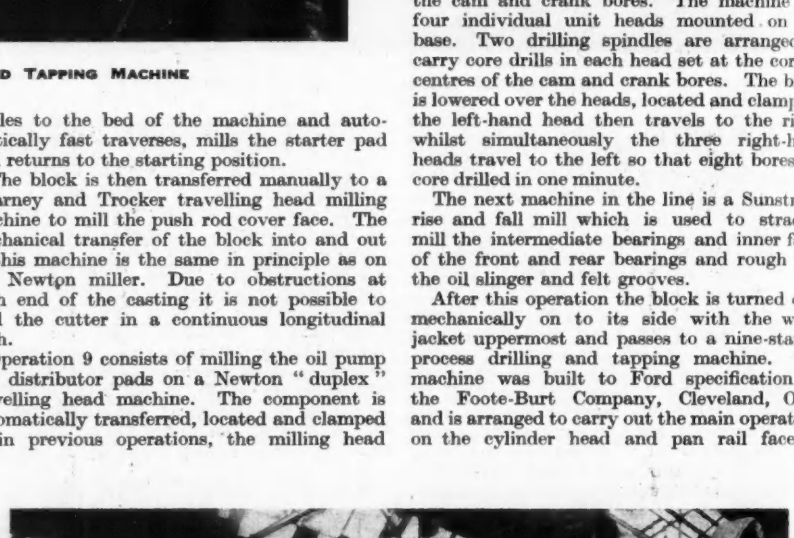
Operation 9 consists of milling the oil pump and distributor pads on a Newton "duplex" travelling head machine. The component is automatically transferred, located and clamped as in previous operations, the milling head moves transversely in its cutting cycle and at the end of the sequence the casting is manually passed to the next machine, which is an Ingersoll "Duplex" mill on one side of which is mounted a spindle carrier embodying two cutter spindles and a single-spindle carrier on the opposite side. The operation is to mill the fuel pump and engine mounting pad on the valve side and the engine mounting pad on the water jacket side. During the automatic sequence the block is hauled into position, located and clamped. The milling heads fast traverse to cutting position, mill the fuel pump head, fast traverse to a lower position to mill the engine mounting pads, fast traverse to starting position and unclamp and eject the block. The heads are arranged to feed down vertically due to restricted cutter space. The block is then turned round manually 90 deg., ready for the next machine.

This is a nine-station automatic process machine for drilling, reaming, tapping, countersinking and boring various holes in each end of the cylinder block. The machine shown on page 767, was built by W. F. and John Barnes, of Rockford, U.S.A., to the specification of the Ford Motor Company and completes eighty-one distinct operations in one minute. As with all these various multi-station process machines, which have been installed, the work is automatically transferred to its respective station once the operator has engaged the starter switch, until the end of the complete cycle. Should any tool become defective the machines are automatically switched off and the location of the tool is indicated on the control panel.

The casting then receives a water test, and after inspection it is passed to a machine designed by the Ford Company to rough bore the cam and crank bores. The machine has four individual unit heads mounted on the base. Two drilling spindles are arranged to carry core drills in each head set at the correct centres of the cam and crank bores. The block is lowered over the heads, located and clamped; the left-hand head then travels to the right, whilst simultaneously the three right-hand heads travel to the left so that eight bores are core drilled in one minute.

The next machine in the line is a Sunstrand rise and fall mill which is used to straddle mill the intermediate bearings and inner faces of the front and rear bearings and rough mill the oil slinger and felt grooves.

After this operation the block is turned over mechanically on to its side with the water jacket uppermost and passes to a nine-station process drilling and tapping machine. The machine was built to Ford specification by the Foote-Burt Company, Cleveland, Ohio, and is arranged to carry out the main operations on the cylinder head and pan rail faces of



FINISH BORING MACHINE

drilling, tapping, countersinking, &c. A combined total of 175 operations is performed automatically during the cycle of this machine. A single control cabinet houses all the various controls necessary to isolate the individual functions of the machine, each of which can be independently activated for setting purposes. When this operation is complete the work passes to a W. F. and John Barnes seven-station drilling and tapping machine illustrated herewith, to drill, countersink, tap and bore ten holes in the distributor and oil pump pads. In principle this is the same as the machine described for previous operations on drilling and tapping.

At this stage various drilling, reaming, countersinking, tapping and grooving operations are performed on the water jacket and valve sides of the cylinder block using a Foote-Burt seven-station process machine as already described.

The component is then loaded into a mechanical turnover unit, which turns the block over through 180 deg., ready to assemble the main bearing caps, which are placed manually in position and assembled, having previously been rough-machined. The block then passes to a three-station cam and crank-boring machine built by the Ingersoll Milling Machine Company, Rockford, Illinois.

The work is automatically transferred to each respective station and ejected at the end of the cycle. The individual unit heads, which carry multi-bladed carbide cutters, are made to very close limits and are interchangeable. The cam bore diameter now being machined to size (1·895in to 1·896in), the component proceeds to a Ford designed machine to insert the camshaft babbit bearing liners.

Finishing operations on the crank bores are carried out on a single-station Ingersoll cam and crank-boring machine, which is similar to the semi-finishing machine previously mentioned, the main difference being that the unit heads are fitted with short boring bars carrying single-point carbide cutters. There are also incorporated in this machine two reaming spindles to ream two dowel holes in the flywheel housing end of the cylinder block. The block is then mechanically turned over 180 deg. to bring the cylinder head face to the top and is loaded into an "Excello" single-spindle boring machine to finish-bore the oil pump and distributor bores.

When the operation is completed the work is passed on rollers to the "Excello" angular-head boring machine illustrated opposite to finish-bore the cylinder bores to 3½in diameter. The machine is fitted with a powered carrier, which loads the component into the fixture at the correct angle of the boring spindles. To ensure that the cylinder head face and the flywheel housing face are at 90 deg. to each other a final cut is then taken on these faces on a Cincinnati two-spindle milling machine.

The cylinder bores are then chamfered at the top and bottom on a No. 3 Archdale cylinder borer preparatory to honing. An allowance of 0·001in to 0·002in is left in the bores for honing, this operation being performed on a No. 320 Barnesdril honing machine, using micromatic hones to a surface finish of 25 to 35 r.m.s. This machine again is a six-spindle machine, will which accommodate either four or six-cylinder blocks.

At this stage the block proceeds through a hot wash, is fitted with the necessary expansion plugs and water tested. After water test it passes through a drying chamber to final inspection, where a 100 per cent check is made.

An Impregnated Pressure Cable for 275kV

LAST week we visited the Erith works of British Insulated Callender's Cables, Ltd., to see one of the stages in the manufacture of an impregnated pressure cable which is designed for operation at 275kV, under conditions that may be expected on the British Electricity Authority's "super" grid.

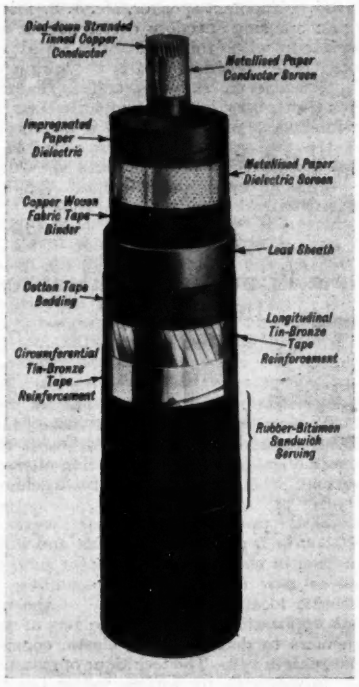
The impregnated pressure cable is distinguished by the fact that nitrogen gas is maintained under pressure inside the lead sheath, the function of the gas being to suppress ionisation and to allow the cable to be operated at higher electrical stresses than those used in solid cables. With a gas pressure of 200 lb per square inch, this particular cable is designed to operate at a maximum stress of 110kV per centimetre at the conductor, under working conditions.

Our illustration shows the make up of the cable, and the accompanying table gives the main dimensions :

275kV Single-Core Impregnated Pressure Cable

	Radial thickness (inch)	Cumulative diameter (inch)
Conductor (0·75 square inch) died-down and screened with metallised paper	—	1·119
Insulation	1·005	3·129
Metallised paper screen...	0·005	3·139
Copper woven fabric tape	0·015	3·169
Clearance	0·035	3·239
Lead Sheath	0·120	3·479
Cotton bedding for reinforcement	0·010	3·499
1 per cent tin bronze reinforcement	0·036	3·571
Rubber bitumen sandwich serving	0·21	3·99

The conductor consists of ninety-one 0·103in tinned copper wires. To make the conductor more nearly cylindrical and, thereby, reduce the stress concentration that would otherwise exist at the small radii of the individual wires, the conductor is died down and then screened with metallised paper tapes. Insulating the screened conductor involves lapping it with about 230 tapes of paper 4 mils thick. We were able to see part of this process being carried out during our visit. The insulation is applied by feeding the cable through a paper lapping machine which is believed to be the largest of its kind in Great Britain. In this machine the cable is drawn through a sequence of thirty-eight lapping heads, each fitted with three lapping spools which are adjustable to give the required "lay" and overlap. Two passes through the machine are required to build up the specified thickness of insulation. As can be seen from our illustration, a copper woven fabric tape is applied over the dielectric screen to protect it and ensure positive contact with the lead sheath.



275kV IMPREGNATED PRESSURE CABLE

After the paper has been applied the cable is vacuum dried and impregnated with a high-grade insulating oil under controlled pressure and temperature conditions for several days. The next operation is the extrusion of the lead sheath surrounding the cable. The lead used contains a small percentage of tin, extensive tests having shown this to be the most suitable alloy for this type of cable. Extrusion of the sheath is carried out by the Glover press technique, a small predetermined clearance being left under the sheath to permit the distribution of gas along the length of the cable after installation.

To limit distention of the lead sheath by the internal pressure of 200 lb per square inch, special metallic reinforcement tapes are applied. These tapes are applied in two layers, the first layer being narrow tapes with a very long lay to provide longitudinal reinforcement, and the second consisting of a double layer of wider tapes applied with a short lay to give the necessary circumferential strength. For a single-core cable the reinforcement must be of a non-magnetic material and 1 per cent tin-bronze has been selected because of its high tensile strength and relatively high electrical resistance which minimises the induced losses.

Finally, the cable is served with a rubber-bitumen type finish consisting of alternate layers of rubber and compounded fabric tapes which, together with the application of a bitumen type compound, provide a high degree of protection against corrosion.

The continuous current rating of this cable, when installed direct in the ground under normal conditions, is 530A corresponding to a three-phase load of approximately 250MVA. The cable will be subjected in the company's research laboratories to a comprehensive programme of tests to prove its suitability for service. Although this is the first cable manufactured by the company for 275kV operation, similar cables for 220kV and 264kV have been manufactured previously and no new problems are involved in the 275kV design.

Technical Reports

Electrostatic Induction between Power Lines and Telephone Lines (Ref. M/T109). By H. R. J. Klewe, D.Phil. The British Electrical and Allied Industries Research Association. Price 12s. 3d. post free.—Discrepancies which have been generally observed between measured values of the induced voltage or current and values calculated by accepted methods are attributed in this report to the existence of stray capacitances which are generally neglected in calculations based on line dimensions, but are of important magnitude. The cause of the discrepancies may be masked by the presence of harmonics in the voltage source from which the lines are energised during measurement. The conclusions are supported by measurements made on experimental lines.

A Sequential Inspection Plan for Radio Interference Testing, with Special Reference to Discontinuous Interference (Ref. M/T100). By S. F. Pearce, B.Sc., A.Inst.P., and H. Goldenberg, B.Sc. The British Electrical and Allied Industries Research Association. Price 12s. 3d. post free.—This report describes a sequential inspection plan for testing appliances which produce a discontinuous type of interference, for compliance with the requirements of B.S. 800, "Limits of Radio Interference." It is shown that this plan will lead to the same decisions as the scheme described in B.S. 800, but with a greatly reduced amount of inspection. The amount of inspection necessary for a decision is also closely related to the degree of suppression applied.

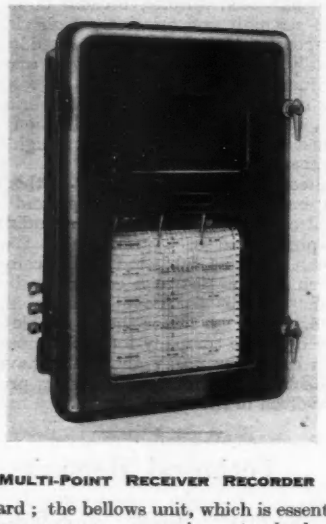
The Influence of Circuit Constants on the Arc Restriking Voltage of Cartridge Fuses (Ref. G/T245). by H. W. Baxter, B.Sc. (Eng.), A.M.I.E.E., and M. T. Cree. The British Electrical and Allied Industries Research Association. Price 7s. 9d. post free.—This is a further report in the series dealing with fundamental principles of fuse operation, the preceding report being Ref. G/T238. The results of tests made with cartridge fuses filled with crushed quartz are discussed to show relationships between fuse or circuit constants and the arc restriking voltage or the recovery voltage.

Among the conclusions reached in this report are that the arc re-ignition voltage of a fuse increases with the length of the arc gap and becomes smaller as the prospective current is increased. It is found that a fuse that persistently fails with small currents may clear the circuit if a capacitor is connected in parallel with it, but with currents greater than about 10A the capacitor becomes impracticably large.

An Air-Operated Receiver-Recorder

We have received particulars of a multi-point, air-operated receiver-recorder which has been introduced by George Kent, Ltd., of Luton, for use in plants where pneumatic as distinct from electrically operated telerecording or telemetering is required. The new instrument, illustrated below, provides a synchronised side-by-side record of the principal measured or controlled variables in a system.

The instrument can be used in conjunction with a transmitter mounted in any of the company's standard mercury or ring-balance flow instruments, "Multilec" potentiometers, pressure or temperature controllers, &c., or with transmitters of other makes provided that they emit the required pressure range. All the components used in the receiver are



MULTI-POINT RECEIVER RECORDER

standard; the bellows unit, which is essentially a pressure gauge, comprises standard components as used in the firm's Mark 20 air-operated control unit.

The receiver records on a chart divided into three distinct zones and can operate on three, four, five or six points. When it is operating on more than three points, and two pens are recording on one zone, different coloured inks are used. Pen travel is 3in for each point, and each pen has a separate "zero" adjuster. The chart is driven by a synchronous electric motor and at the standard speed will last for two months. The instrument incorporates an air filter, pressure reducing valve, moisture sump and pressure gauge. Air connections are by unions to nipples on the side of the meter case. The system air pressure range is 3 lb to 15 lb per square inch, and the maximum working distance the unit can operate from the transmitters is 1000ft. The mechanism is enclosed in a cast aluminium case, which is suitable for wall or flush panel mounting, and has a dust-proof door.

Tapered Roller Bearings

Chief mechanical engineers and executive engineering staff from the railways of some nine Commonwealth and Continental countries were guests at a railway symposium organised recently by British Timken, Ltd. In the course of the symposium the visitors made tours of inspection to the company's various works, where they were given every opportunity to see all the stages of tapered roller bearing manufacture and the many types of bearings produced. Each day members of the company's staff presented papers dealing with the design, manufacture, application and maintenance of tapered roller bearings, as applied to railway working. At each stage of the proceedings the visitors were able to put before the staff particularly concerned their individual problems and to discuss all aspects of the bearings from the materials used to the final inspection and testing of units.

The symposium concluded with a dinner in London on May 24th, at which there were present visitors from many countries, including France, Switzerland, Norway, Denmark, Austria, Australia, East Africa and Turkey. In proposing the health of the visitors, Mr. Pascoe, the chairman and managing director of the company, said that the symposium was the first of its kind to be held. He stressed the value of such personal contact between a manufacturer and the users of railway equipment from other countries, not only in the goodwill it promoted but in the fact that it made possible the open discussion of individual problems by the people most closely concerned on both sides. Such discussion was of considerable benefit to industrial progress and efficient development on the right lines. He mentioned that one of the guests, Mr. H. J. S. Moyses, represented the Birmingham Railway Carriage and Wagon Company, Ltd., which company had first used the Timken tapered roller bearing on rolling stock. These original bearings had already run over two million miles in service on the Egyptian State Railways.

Replying to Mr. Pascoe, Mr. H. Christensen, of the Danish State Railways, expressed the appreciation of the visitors for the interesting and instructive time they had spent during the symposium. He said that the visitors had broadened their knowledge of the design and construction of Timken bearings and had been particularly impressed by the high standards of materials used and the manufacturing methods developed by the company. He asked Mr. Pascoe to accept a book, which he presented on behalf of the visitors, as a token of their appreciation for the kindness and hospitality they had received. The next speaker, Mr. J. S. Tritton, after an amusing anecdote describing his early experiences with roller bearings, said that tapered roller bearings had a very wide field of application on railways and in industry. Various members of the company then said how interesting and instructive it had been to meet the visitors from different parts of the world, discuss their problems and show them the technical background behind the sales organisation.

New Principles in Electrical Instruments*

By D. C. Gall, M.I.E.E.

Ultrasonics

The generation and use of ultrasonic vibrations is a new principle which has found many applications in recent years. Although there are mechanical methods of producing ultrasonic vibrations, there are no purely mechanical methods of receiving them satisfactorily. Mechanical pressure and shear waves of 20–10,000 kc/s generated in solids and liquids have been in use for many years for such purposes as flaw detection, echo sounding and submarine location at sea. One of the more recent applications has been the use of these frequencies to determine the elastic constants of materials in situ. The technique of measuring strain in materials by various means has been highly developed,[1] but the modulus of elasticity must also be known to determine the stress. By the measurement of the velocity with which a pulse of waves of ultrasonic frequency travels in the material under test, the elastic properties can be determined. The method consists of measuring the time interval between the transmission of a pulse of supersonic frequency and its reception at the boundary, or the reception of the reflected pulse back to transmission boundary.

A pulse of short duration is generated by a magnetostriction of piezo-electric oscillator excited by a pulse generator. The pulse is transmitted into the medium and the instant of transmission recorded on a cathode-ray oscillograph. The reception of the direct or reflected pulse, measured by means of suitable piezo-electric devices, is then recorded by the oscillograph, on which the trace is synchronised with the pulses, at a known constant speed. The time of travel is given by the distance between the two signals. The pulsing frequency is sufficiently high to give a continuously visible signal, but low enough to allow each pulse to be received before the next one is sent out, usually about 50 pulses per second.

From the speed of transmission and density of the medium, Young's modulus can be determined by the simple ratio

$$E = (\text{speed})^2 \times \text{density}.$$

Similarly, Poisson's ratio and the volume elasticity can be determined by the speed of transmission in a cube.

The same technique is also being used as a

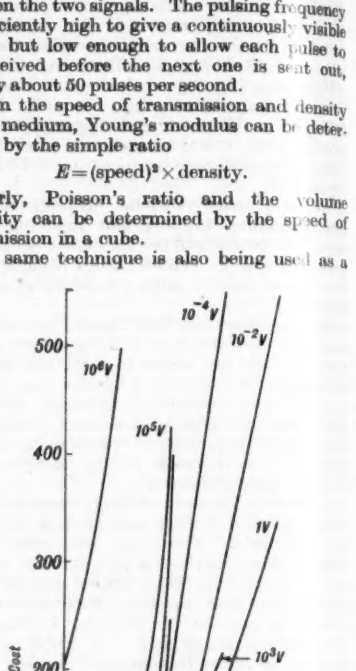


FIG. 1.—*Variation of Cost of Accuracy of Measurement with Voltage—Cost in Arbitrary Units*

depth gauge. In this case, a standardising gauge consisting of a medium of variable known depth—such as a column of liquid—is so arranged that it can be switched in parallel with the unknown medium. By superimposing echoes and varying the depth of the medium, accurate depth readings can be obtained. For example, depths from ¼in to 12ft in steel or aluminium can be measured to within about 1 per cent. In this application the cathode-ray oscillograph can be replaced by any other synchronous recording device, such as those used in echo sounding, since the time intervals measured are relatively long. The method is said to be capable of measuring the depths of solid fuel in tanks or even in blast-furnaces. It is even claimed that automatic controllers can be operated by this method.

Another recent application of the ultrasonic principle is the use of calibrated variable frequencies in an oscillator-receiver to find resonant frequencies in the medium under test. Standing waves can be set up in the medium by adjusting the frequency, and their presence can be detected by the maximum amplitude of the transmitted signal, modulated at audio frequency to make detection easy. Various mechanical properties, such as thickness, can be determined by this means. The interesting point of this method is that it is the impedance of the mechanical system which is used, very similarly to many purely electrical methods.

Pulse Techniques

As was shown in a recent paper,[2] the pulse technique has been applied to the simultaneous indication of the out-of-balance readings of a large number of strain-gauge bridges. The combination of electronic switching and synchronous pulsing is a very impressive method

* Abstract. The Institution of Electrical Engineers. Conference on Electrical Instrument Design, May 28th to 30th.

of obtaining a continuous picture of a large number of changing phenomena.

In reviewing new principles, brief mention should be made of the application of radioactive methods. Gamma-rays are now being used in problems where other methods have been less successful, such as in measuring the corrosion in pipes or vessels without interrupting their use. A radioactive pellet is used as the source of γ-rays, which have great penetrating power and can be used to measure the thickness of steel plates or pipes up to 0·75in thick. With various modifications to the circuits they can be used to measure corrosion in pipes and vessels containing chemicals under pressure without opening up the pipes or vessels. The radiation from the pellet, after passing through or being reflected back from the boundary, is received in an ionisation chamber and amplified into a suitable indicator. By using a radioactive pellet on a float, the height of a liquid inside a sealed pressure tank can be measured. Such a scheme has been used for the automatic control of sludge level in a totally enclosed pressure system. These and similar methods may have much wider application as the technique develops.

The use of the resonant frequency of the ammonia atom or isotope as a standard of time is a new principle of interest,[2, 4]. The technical achievement in picking out this absorption line in an ammonia-filled chamber forming part of a waveguide is a striking example of the application of modern technique in the generation and measurement of very short waves culminating in the synchronisation of the visible clock.

It is interesting to reflect that both the ultrasonic and γ-ray methods and the absorption technique are applications of new portions of the frequency spectrum to measurement. Thirty years ago the frequency spectrum had many gaps in it which had never been subjected to measurement. Since then, the progress of filling in these gaps has been steady and new measuring principles have been conditioned largely by the use of new frequencies. The generation and measurement of the v.h.f. radar waves and the infra-red waves are both similar examples of developments in frequency-spectrum measurements made during recent years. To these may be added the generation and measurement of nuclear particles.

The Relationship Between New Principles and Economic Manufacture

The utilisation of new principles depends upon economic factors. There have been many discussions on the value of accuracy, for example, in supply-meter calibration. Is it better to charge the customer less with large possible errors, either way, or make him pay more for a smaller margin of error, since the cost of more accurate measurement must be reflected in the price he must pay? Excessive accuracy is seldom economical. The accuracy required in any measurement should be settled on purely economic grounds, but it is usually dictated by some specification for the properties which a material must possess or the performance which an instrument must have. In a few cases—such as in research—the ultimate accuracy is desired, almost irrespective of cost, but even then it is never entirely independent of that overriding spectre. It is usual to draw a graph of cost against accuracy and to decide from this where to stop. There are seldom any points of inflection in the working part of such a curve. Fig. 1 gives curves showing the relative cost of measuring voltage to different degrees of accuracy. A glance at this curve shows that it costs about twenty times as much to increase the accuracy of measuring 1V from 1 to 0·01 per cent, that the most economic accuracy is in the 1V range, and that some high voltages cannot be measured accurately at any cost. These are typical limiting factors which will be found in almost any examination of the relationship between the cost and accuracy of measurement. It is when the cost of present methods becomes prohibitive that the need for new principles in that particular range of measurement becomes most pressing. Choice of an instrument or method of making a particular measurement on the basis of economy can be decided only by considering the cases individually. There is no general solution which can be formulated.

Certain principles in instrument design can be examined from the economic standpoint, and these require to be considered when new principles of measurement are being applied.

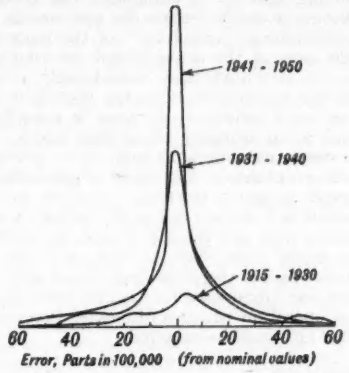


Fig. 2—*Growth of Accuracy of Resistance Standards during 1915–50*

It is possible to be wasteful of materials, skill, standing charges and performance with a badly designed instrument.

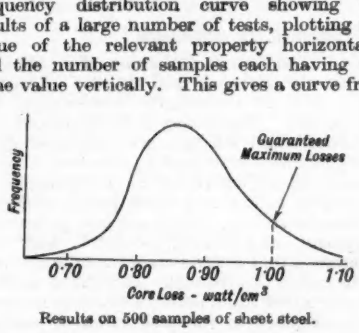
The economic aspects of instrument design may be reviewed under four headings:

(*a*) Economy of purpose.
(*b*) Economy of method.
(*c*) Economy of construction.
(*d*) Economy of use and maintenance.

Under (*a*) may be considered the range of measurement which is to be covered, the accuracy necessary, the speed and the form of presentation which the instrument shall give. The desirability of extending the utility of the instrument to wider needs which may arise, and so to avoid additional instruments later, should also be considered under this heading.

Economy of method is a fundamental matter, and upon the decision made will depend the whole success and, therefore, the overall economy of the design; it is at this stage that the use of a new principle arises. The best method of measurement must be used, but the best is a very conditioned superlative and a new principle may offer advantages.

It is convenient to present the performance of a material or component in the form of a frequency distribution curve showing the results of a large number of tests, plotting the value of the relevant property horizontally and the number of samples each having the same value vertically. This gives a curve from



Results on 500 samples of sheet steel.

Fig. 3—*Distribution of Iron Losses*

which the probable value of a sample of the material can be anticipated. If the scatter is too wide or too random, the material has obvious limitations where uniformity is desirable, and an economic design cannot be produced because careful selection will greatly increase the cost; furthermore, in those devices where matching is essential, it may be impossible.

As an example of the improvement which takes place as the art of manufacture progresses, Fig. 2 shows this type of curve applied to resistance coils produced during thirty-five years of development. The reduction in scatter value clearly shows the progress which has been made in the quality of the material and the workmanship between 1915 and 1950.

I am indebted to Mr. G. C. Richer for Fig. 3, which shows the results of about 500 tests in the iron losses in sheet steel. Ideally, these samples should all have the same value, but, in practice, the properties are distributed in a characteristic curve. From this distribution it follows that to select material of the highest performance would probably involve about ten times the average cost. This would be a serious objection in any reproducible design. Little change appears to have taken place in this distribution curve over the last twenty years. Obviously, therefore, a new material is necessary to obtain a performance outside this curve of probability.

Economy of construction depends upon the number of instruments to be made, the conditions under which they are to be used and the facilities available for their manufacture. The smaller and lighter the design, the greater the economy of material, but rigidity and the clarity of the display of the dials should also be adequate. The smallest reading should be distinguished easily by whatever means is chosen to display it.

It is interesting to consider the economic aspects of the choice of dials such as might be needed in a resistance bridge or potentiometer. Supposing the degree of subdivision of the total to be 1 part in 10,000, it is easy to show that the most economic means of providing this degree of subdivision is by the use of a binary scale of units instead of a decimal one. Such a system would be met by using only twenty-five coils and thirteen two-position switches, as compared with the minimum of thirty-seven coils and four ten-position dials in a decade system.

The binary system of units has so many economic advantages from a measurement point of view that one wonders how we ever came to accept the decimal system in its place, for the ancient systems were on a binary basis and modern calculating machines use a binary system of numbers for economic reasons.

If all measurements had been built upon a binary scale, only 2 : 1 ratios would be required to build the entire system. Doubling and halving are such simple processes in any measurement that it is a great pity that we have not retained it in scientific work. In a binary system of numbers, no multiplication table is needed and the only digits required are the symbols 0 and 1. Twice 1 becomes 10, twice 10 becomes 100, and so large numbers would have more digits, but abbreviation would be simple. The fractions would be equally simple—½, ¼ and ⅛ being 0·1, 0·01 and 0·001 respectively. Only the logarithm of 2 would be required for all the elementary process of multiplication and involution. In measurement, the ratio of 2 : 1 would be much more convenient than the large value of 10 : 1 at present used, and in the standardisation of such things as resistance coils the advantages of building up by series and parallel connection is obvious.

The decimal system is too well established now to be replaced by the more economical binary system, but a review of economic factors in relation to new principles would be incomplete without this reference. There are still cases where the binary system of building up values may be worth while. Apart from calculating machines, examples are loading resistances and reactances, where economy can be effected by the use of binary units.

No mention has been made of the great developments which have taken place in the measurement of nuclear particles, since this has been fully covered by a recent symposium.[5] Similarly, the resistance strain gauge has been exhaustively dealt with elsewhere.

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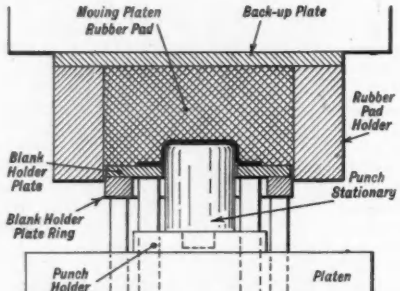
[2] Yates, J. G., Lucas, D. H., and Johnston, D. L., "Multi-Channel Measurement of Physical Effects by Confluent Pulse Technique, with particular reference to the Analysis of Strain," "Proceedings," I.E.E., 1951, 98, Part II, page 109.
[3] Smith, H. M., "The Determination of Time and Frequency," "Proceedings," I.E.E., 1951, 98, Part II, page 143.
[4] Essen, L., "Frequency Standardisation," *ibid.*, page 154.
[5] "Symposium of Papers on Radiation Monitoring Apparatus," *ibid.*, page 173.

American Engineering News

(From our American Correspondent)

A Forming Process for Sheet Metal Parts

An interesting process for the forming and drawing of shapes has been developed by the Glenn L. Martin Company, of Baltimore, Maryland, in co-operation with Hydropress, Inc., of New York. It is intended primarily to be employed in the aircraft industry where both batch and quantity production operations occur. The two processes which preceded this so-called "Marform" process and established its background are the rubber pad process of forming, employing a steel punch and a rubber pad, and the conventional deep drawing process, making use of a steel punch and a steel die. A typical arrangement of the essential components used in the "Marform" process is reproduced in the accompanying drawing. Attached to the moving platen of a hydraulic



THE "MARFORM" PROCESS

press are the rubber pad and the pad holder. The male forming punch is mounted on the stationary lower platen of the press. Below the rubber pad are the blank holder plate and the blank holder plate ring, which rest on pins supported by a hydraulic cylinder. In the illustration shown, the unit has partly formed a metal cup. At the beginning of the forming operation the rubber pad and the pad holder are raised to permit the insertion of the flat blank on top of the punch. At this stage, the blank holder plate is flush with the face of the punch. The rubber pad and the holder are then lowered, the rubber pressure first clamping the blank against the upper face of the punch; as this downward motion continues, the additional pressure of the rubber on the blank causes a rolling down of the blank over the punch. The latter causes a downward motion of the blank holder plate which is resisted by the pressure pins. The function of the rubber pad is to apply sufficient pressure to prevent wrinkling of the material as the drawing or forming operation takes place and the metal flows towards the punch. Each change in pressure causes a change of condition of the rubber pad. Experience has shown that the lower pressures permit large forming radii in the rubber, providing for easy flow of the metal, and higher pressures are applied to reduce the radius progressively until the desired condition is obtained. Occasionally, a very high final pressure has been helpful in setting a small radius at the end of a draw. In a typical forming operation a 1⅞in diameter cup was drawn to a depth of 1¾in, using "2 S–O" aluminium alloy. The initial pressure was 624 lb per square inch; at a depth of ¼in the pressure was increased to 1560 lb per square inch, while at ⅜in depth it rose to 3130 lb per square inch. From that point on it continued to increase up to a maximum of 5000 lb per square inch when the full 1⅞in draw was completed. Close control of the forming pressure is obtained by an arrangement of valves which control the pressure of the hydraulic system during the forming stroke of the machine and also control the return of the oil to the hydraulic cylinder for stripping the component from the male form. Pressure variation during the forming stroke is facilitated by the action of a roller which follows the contour of an adjustable cam. Slides for adjusting the cam are graduated, so that once an initial set-up has been made, the settings can be repeated readily for later operations of a similar kind. The "Marform" process is claimed to offer considerable savings in tooling cost as it eliminates the need of machining a costly female die and avoids the time-consuming "matching" of the male and female tools of the conventional drawing process. It is stated that considerably deeper draws can be obtained with the process, and a 57 per cent reduction in area is considered normal when working aluminium alloys. In some cases, reductions as high as 70 per cent have been obtained. The depth of cut normally expected in the "Marform" process in one operation is $1 \cdot 5r$ (where r is the radius), which compares with the value of r usually expected when using steel dies in the conventional manner. It has therefore been found that the process can frequently be used to form a part in one operation whereas otherwise two stages of drawing would be required.

M.I.T. Conference on Prestressed Concrete

Preliminary plans have been announced for a national conference on prestressed concrete, to be held at the Massachusetts Institute of Technology, from August 14th to 16th of this year. Its purpose will be to consider questions which have to be answered before the use of prestressed concrete can be extended fully in American construction practice. The main topics of discussion will be the present and possible future applications of prestressed concrete construction, the manufacturing and construction techniques involved and the problems in research and design presented by the use of prestressed concrete. There will be emphasis on the problems of design and construction practice in the U.S.A. and their relation to practices already adopted in foreign countries. The conference will be under the direction of Professor Myle J. Holley, Junior, of the department of civil and sanitary engineering, and Professor Howard Simpson, of the department of building engineering and construction.

South African Engineering News

(From our South African Correspondent)

Industrial Developments

The foundation stone of a £500,000 factory for Babcock and Wilcox of Africa (Pty.), Ltd., at Duncanville, Vereeniging, was laid recently. The factory is being erected on a 46-acre site and will have an initial floor space of approximately 100,000 square feet. It will include, in its activities the manufacture of water-tube boilers and other pressure vessels, mechanical stokers, conveyors, coal pulverising equipment, and general steelwork, and it is understood that electric cranes will be included in the range of products. The fusion welding process, X-ray examination and stress relieving will be applied in the production of pressure vessels and boiler drums. It is expected that the factory will be ready to go into production in twelve months' time.

A new factory for British Timken, South Africa (Pty.), Ltd., was officially opened recently at Benoni, Transvaal. The factory has a floor area of 22,000 square feet, and some 150 employees are now at work in the factory. The products manufactured include a variety of railway and mining equipment, including axle-boxes, headgear sheave pedestal bearings, and many sizes of mine car wheels for cars from 1 ton to 40 tons capacity.

A third engineering development is the manufacture of earth-moving equipment by Gearing and Jameson, Ltd., which is now producing scrapers of American design with capacities of 2, 3, 4¼ and 6¼ cubic yards. Standard equipment includes a double-edged reversible blade, high-pressure hoses for the hydraulic system, and automatic self-sealing couplings. High ground clearance is afforded in the carrying position. A special feature is the reinforced "goose-neck" mounted on the front carriage by means of an easily accessible alloy steel and phosphor-bronze ball and socket joint. The 4¼ cubic yard scraper has an overall length of 19ft 4in and overall height of 7ft 6in. The wheel base is 12ft 9in. The width of cut is 7ft and maximum depth of cut is 7in, with an empty weight of 3700 lb. This scraper can be drawn by a tracked tractor of 35 h.p. or a wheeled tractor of 48 h.p. The 2 cubic yard model is designed for use with a light farm tractor. It is interesting to note that the only imported components on the South African built models are the wheel discs.

Another new industry which has been introduced to South Africa is the manufacture of cold-rolled sections by J. Brockhouse (South Africa), Ltd. Both ferrous and non-ferrous metals can be used, and sections up to 100ft in length can be produced, although normal requirements do not exceed lengths of 20ft. The great strength-to-weight ratio and other advantages of cold-rolled sections are making these products increasingly popular, and it is expected that this new venture will prove to be of great service to South African industry generally.

South African Railways Progress

According to the Minister of Transport, the Hon. P. O. Souer, in his recent address to Parliament on the railway budget, the outstanding improvement of the year 1950 has been the increase in goods traffic. Generally speaking, traffic during 1950 reached the highest levels ever experienced. In the period January to November, 1950, the total tonnage of goods transported by rail amounted to 55,854,883 tons, an increase of 3·6 per cent over the corresponding period of 1949. Despite the overall increase in goods traffic, total train and locomotive miles decreased, thus reflecting greater loading and operating efficiency, which can be ascribed partly to the economies effected by the detailed examination and reorganisation of train services on all systems and the hauling of larger loads, especially with the class "24" engines, 100 of which were placed in service during 1949–50.

The estimates for 1951–52 have been made on the basis that present traffic demands will show some expansion. The long sections of single track on some of the main lines between the coast and the interior have become a severe handicap, and the doubling of a number of these sections is proposed. On the Natal main line, for example, which carries a considerable tonnage of export traffic, such as coal and manganese, operating conditions were rendered difficult at times by the long stretch of single track between Pietermaritzburg and Ladysmith. During the current financial year two sections where the doubling has been completed were opened between Tweedie and Lions River and between Dargle and Lidgetton. Work on other sections is now in hand.

For a number of years it has been the policy of the administration, when relaying the permanent way on main lines, to replace the 80 lb rails by 90 lb sections. During the war years this track-strengthening programme was considerably delayed, but now it is preceeding at a faster pace. Adequate ballasting of the track has always been one of the administration's difficulties, due to the lack of quarries at strategic points. It was therefore decided a few years ago to establish quarries for supplying ballast at convenient places in different parts of the country. These quarries are now going into production.

Information about various research work for the administration is contained in the general manager's annual report. It is stated, for instance, that the use of synthetic sand—a mixture of washed sand, coal dust and a binding substance—in the manufacture of castings has proved most satisfactory, and, apart from considerable production economies, the saving in haulage from the use of this sand is an important factor.

Industrial and Labour Notes

The Treasury and Electricity Supplies

In his chairman's address at the annual meeting of Johnson and Phillips, Ltd., held in London on Thursday of last week, Mr. G. Leslie Wates referred to the grievous restrictions imposed by the Treasury upon the capital programme of the British Electricity Authority, both in relation to generation and distribution. It was, he said, a long-term question which, in his opinion, did not receive the publicity and discussion which it deserved.

Electricity, Mr. Wates emphasised, was the lifeline by which we should save ourselves from economic disaster. It was useless, he considered, to ask the housewife to go into the factory to work if she could not have quick and clean means at her home of cooking the family's food and providing the family with warmth and hot water. Electricity was the means to the end and not the end in itself. According to the Minister of Fuel and Power, Mr. Wates continued, the loss to industry as a result of electricity cuts could be put at about £8,000,000 a year, but within the industry it was thought that that figure should be put much higher. If, Mr. Wates pointed out, the capital represented by an income equivalent to that loss were used in creating new generating stations the country would probably have all the electricity it could use. The result would be a considerable increase in productivity with a corresponding improvement in our export trade and in our economic position generally.

Mr. Wates went on to say that he could only hope that, by constant reiteration in season and out of season, ultimately some glimmer of light would penetrate the Stygian darkness of Whitehall with some practical result, but, as he had mentioned, it was a long-term question. Even when a generating station had been decided upon it took two years before the necessary licences could be obtained to enable one sod of earth to be turned over for the foundations. The power cuts we were suffering to-day would not be avoided by a reversal of the Treasury policy, but those we should suffer from in 1956 or thereafter might be so avoided.

Trade Disputes

The Ministry of Labour says that 176 stoppages of work through industrial disputes were reported as beginning during the month of April and that fourteen stoppages, which started before April, were still in progress in the early part of that month. These 190 stoppages affected 46,100 workers and caused an aggregate loss during April of 153,000 working days. By far the larger part of the stoppages—118 in all—occurred in the coal-mining industry, though the stoppage of work by electricians employed on contracting work by the London, Eastern, South-Eastern and Southern Electricity Boards resulted, during April, in an aggregate loss of 23,000 working days. In the first four completed months of this year, 565 stoppages of work through disputes were reported in the United Kingdom, involving 128,500 workpeople and causing a loss of 715,000 working days. In the corresponding period of last year there were 509 stoppages, which affected 101,500 workers and resulted in a loss of 441,000 working days.

The latest issue of the *Ministry of Labour Gazette* contains an analysis of the stoppages of work through disputes, which occurred in this country last year. Altogether, there were 1339 such stoppages, involving about 303,000 workers and causing an aggregate loss of 1,389,000 working days. The coal-mining industry accounted for nearly one-third of the total loss of time and the Ministry says that stoppages in the engineering, shipbuilding, vehicles, iron and steel and other metal industries accounted for more than one-fifth of all the time lost in the year. In this group of industries there were no stoppages involving very large numbers of workers, but in February and March, 1950, more than 35,000 working days were lost by about 1500 workers in the motor vehicle manufacturing industry, who objected to a shop steward being declared redundant. A demand for the withdrawal of notices given to redundant workers and a claim that the management had failed to provide for continuity of employment led to a stoppage of work from mid-October to mid-December by about 900 workers employed in motor-body building and involved a loss of approximately 36,000 working days.

Changes in Wage Rates

Changes in rates of wages, reported to the Ministry of Labour as taking effect in the United Kingdom during April, resulted in an aggregate increase of about £360,000 in the weekly full-time wages of 1,102,000 workpeople. Among those who received increases were workers employed in the iron and steel industry, the gas industry, electrical installation and in waterworks undertakings. In the iron and steel industry the increase amounted to about 8½d. a shift for men in most districts, resulting from a rise in the index of retail prices and a revision of the sliding scale arrangements based on the index. In the gas industry there was an increase in the standard rates of 2½d. an hour for day-workers and 1s. 8d. a shift for shift-workers in the Metropolitan area and of 1¾d. an hour for day-workers and 1s. 2d. a shift for shift-workers in provincial districts, with corresponding increases for pieceworkers. From the beginning of January to the end of April, the Ministry of Labour says, changes in wage rates resulted in an aggregate increase of £2,242,700 in the weekly wages of 5,802,500 workers. In the comparable period of 1950 there was a net increase of £366,200 in the weekly wages of 2,246,500 workers. The index of rates of wages (June 30, 1947=100) now stands at 118 for all workers, as against 114 at the end of last year.

The Price of Nickel

Last week the International Nickel Company of Canada, Ltd., announced the conclusion of new agreements with the labour unions, the principal points of which are the reduction of the working week from forty-four to forty hours, without reduction of pay, and an increase in basic rates of wages. The company added that the effect of the new agreements and of increased plant costs would add about 15,000,000 dollars a year to its production costs. A later announcement from the International Nickel Company and its associate, the Mond Nickel Company, Ltd., related to increased prices for nickel, which took effect on June 1st. The Mond Nickel Company's price for refined nickel in the United Kingdom is now £454 per ton delivered to consumers' works.

Non-Ferrous Scrap Prices

Because of the recent increases in the price of copper and nickel, the Minister of Supply has made a new Order increasing the maximum prices of non-ferrous scrap. This Order, known as the Non-Ferrous Metals Prices (No. 5) Order, took effect on June 4th. Prices for copper scrap now range from £180 to £222 a ton; gunmetal scrap is now £223 and £263 a ton; cupro-nickel scrap £217 to £257 a ton; gilding metal scrap is £210 a ton and the price of various grades of brass scrap is from £163 to £200 a ton.

The Order also provides that builders' merchants may be paid a commission of 1½ per cent on re-melted lead and fixes a new price of £115 a ton for old zinc free from tar.

Railway Labour

The chairman of the Railway Executive, Mr. John Elliot, made a statement in London at the end of last week about the present labour shortage on British Railways. Earlier in the week it had been stated that summer train services would begin a fortnight later and end a fortnight sooner than had been originally planned. The reason, Mr. Elliot explained, was that it was becoming more and more difficult with the shortage of manpower on the railways to deal with the growing volume of freight train traffic necessary in connection with the export drive and the rearmament programme. Mr. Elliot said that there were now nearly 16,000 railwaymen doing National Service and before the end of the year another 7000 were likely to be called up, although 5000 were sure to return. The railways would then have 18,000 men in the forces, of whom 2400 were engine cleaners and firemen. There were, he added, not enough drivers, shunters, firemen and guards on the railways to clear up the accumulation of freight trains and put on the summer passenger service at the same time. The Executive, Mr. Elliot stated, was doing all it could to get staff, but jobs in the open that involved shift-work and Sunday work did not appeal to young men when they could get jobs that gave them every Saturday and Sunday free. Furthermore, it was difficult to transfer men while there was a housing shortage.

Work Study

The British Institute of Management has published this week a paper on "Work Study," which has been prepared by Mr. R. M. Currie, A.M.I.C.E., who is the head of the work study section in the technical department of Imperial Chemical Industries, Ltd. The paper claims that work study can play a significant part in the continuous process of raising the general level of productivity, without which, Mr. Currie observes, economic progress is impossible. It then sets out various techniques of work study. Mr. Currie goes on to suggest that work study is chiefly common sense, but he urges that it should be an attempt to order common sense so that its application becomes more a matter of routine and less the product of inspiration. The main purpose of work study, according to Mr. Currie, is to obtain facts and then to use those facts as a means to improvement. Those facts, the paper indicates, should relate to the most effective use of existing or proposed plant; the most effective use of human effort, and the proper performance of those employed.

The paper, price 3s. 6d., can be obtained from the Institute at 8, Hill Street, London, W.1.

An International Management Congress

The ninth International Management Congress is to be held in Brussels from July 5th to 11th, under the guidance of the International Committee of Scientific Management. The Congress will, it is hoped, provide an opportunity for a full exchange of experience on management techniques and problems.

Twelve introductory reports on selected subjects are to be presented, their preparation having been undertaken by the national member organisations of the international committee. The reports and the countries of their origin are as follows: Structure of Large Enterprises (Great Britain); Work Measurement (U.S.A.); Working Methods and Personal Effectiveness of Top-Managers (Sweden); Fundamentals in Effective Farm Management (Brazil); Establishment of a Sense of Common Purpose Between Management and Employees (France); Recent Developments in Quality Control (Great Britain); The Flexible and the Variable Budget (Netherlands); Job Evaluation (Switzerland); Tested Procedures for Reducing Unit Costs of Distribution (Belgium); Advanced Procedures in Public Administration (U.S.A.); Education for Management (U.S.A.), and Home Design for Simplified Household Routines (Norway).

Fuller details about the Congress and its membership can be obtained in this country from the British Institute of Management, 8, Hill Street, London, W.1.

Notes and Memoranda

Rail and Road

A C.P.R. Retirement.—Mr. H. R. Naylor, works manager for the last ten years of the Canadian Pacific Railway's Angus shops, Montreal, has retired. He has been succeeded by Mr. W. D. Dickie, assistant works manager (locomotive) at Angus since 1948. Mr. Naylor has been in railway service for over fifty years. He started his career in this country with the old North-Eastern Railway at Hull. He joined the C.P.R. Angus shops in 1907.

British Transport Traffic Receipts.—Traffic receipts on British Railways, in the four-week period ended May 20th, amounted to £28,267,000, compared with £24,537,000 in the corresponding period of 1950. Provincial and Scottish road passenger receipts were £3,238,000, compared with £2,572,000; London Transport traffic receipts were £4,699,000, compared with £4,393,000, and Inland Waterways tolls and freight charges amounted to £137,000, compared with £127,000.

Kirkbride Railway Accident Report.—The report has now been published of the inquiry by the Ministry of Transport's Inspecting Officer of Railways into a passenger train derailment which occurred on October 23, 1950, near Kirkbride, on the Carlisle–Silloth branch of the London Midland Region, British Railways. The train was completely derailed as it was travelling at about 45 m.p.h., the engine was overturned and the driver and fireman were killed. There were only twenty-four passengers in the train, three of whom suffered minor injuries. The Inspecting Officer concludes that the cause of this accident was that the track was not in a fit state to carry trains at moderately high speeds, especially those hauled by such heavy engines as the "J 39" class on this particular train. The rails were due for renewal, but the work had been postponed because of the general shortage of track materials. No speed restriction had, however, been imposed. The Inspecting Officer agrees that the decision to be taken by the engineer on the imposition of a speed restriction is a difficult one and the responsibility on him is considerable. But, the report says, for so long as a shortage of track materials or line maintenance staff exists, speed restrictions will be necessary; engineers will, therefore, continually have to face the problem and "they should, if anything, err on the side of safety."

Air and Water

New Union Castle Liner. The "Kenya Castle," the second of the three 17,300-ton, one-class ships now under construction by Harland and Wolff, Ltd., for the Union Castle Line's round Africa service, is to be launched at Belfast on June 21st.

Chamber of Shipping.—At a Council meeting of the Chamber of Shipping on May 31st, the major issue of taxation was discussed and regret expressed that the Chancellor of the Exchequer was unable to receive the representatives of the shipping industry. The opinions put forward were listened to by the Economic Secretary of the Treasury, and it is hoped that they will influence the initial depreciation allowance question. It was noted that the North Atlantic Planning Board has adopted a plan for the emergency allocation of shipping resources of the North Atlantic treaty powers, and it was hoped that the increased prosperity of the Suez Canal Company would result in reduced transit dues. The pollution of sea water by oil is again under consideration on an international level and the Chamber has undertaken to help the Ministry of Transport in the collection of information. German and Japanese shipping developments were considered, and the Council has emphasised that neither country should be allowed to attain an unfair competitive position and that both should fully comply with international shipping conventions.

Miscellanea

A Swedish Ore Concentration Plant.—A new ore concentration plant, which is claimed to be one of the biggest in Europe, is being built by the Boliden Mining Company in North Sweden. The plant is being constructed in two sections, and when it is completed, early in 1954, will have a total annual capacity of 1,000,000 tons.

Electronics Exhibition.—The sixth annual exhibition organised by the North-Western Branch of the Institution of Electronics will be held at the College of Technology, Manchester, on July 24th (from 2.30 to 9.30 p.m.), and on July 25th and 26th (from 10 a.m. to 9 p.m.). The display will include, besides the products of trade exhibitors, a non-commercial section of exhibits from scientific associations and from the universities. There will be an exhibition of modern scientific films and an amateur short-wave radio transmitter/receiver will operate throughout the period of the exhibition. Admission will be by tickets obtainable from Mr. W. Birtwhistle, Hon. Sec., N.W. Branch, Institution of Electronics, 17, Blackwater Street, Rochdale, Lancs.

Easington Colliery Disaster.—The Minister of Fuel and Power has directed Sir Andrew Meikle Bryan, F.R.S.E., Chief Inspector of Mines, to hold a formal investigation into the causes and circumstances of the accident which occurred at Easington Colliery, County Durham, on Tuesday, May 29th. As this investigation is to be held under Section 83 of the Coal Mines Act, 1911, the proceedings will be in open court.

The Steel Foundry as a Career.—A booklet has been published by the British Steel Founders' Association, of 301, Glossop Road, Sheffield, 10, with a view to interesting young men in the steel foundry as a career. The book, in addition to giving concise particulars as to how a steel casting is made, discusses the prospects offered by steel foundries and gives particulars of the careers of a number of the well-known personalities in the industry.

Caribbean Oil Refineby.—The Minister of Fuel and Power was asked, on June 4th, what steps were being taken to expand oil refining capacity in British Caribbean territories. In reply, he said that Trinidad was the only British territory in the Caribbean where refining was done. During the last three years, the Trinidad Leaseholds Company had increased the output of its refinery at Point-a-Pierre by one-third, and was now producing about 3,250,000 tons a year. The plant was being modernised and a catalytic cracking unit was being erected. When that work was done, the Minister stated, the plant would produce a wide range of high-quality products.

Electricity Supplies.—Answering a Parliamentary question, the Minister of Fuel and Power, Mr. Noel Baker, said recently that plans had been made to expand the production of electric power as much and as rapidly as the available resources would allow. Consultations with the Economic Co-operation Administration were taking place, but even if it were possible for the Administration to give this country any help, the main burden of the programme must be met from resources here. The Minister went on to say that last year 965MW of new capacity were brought in, and that this year somewhere between 1050MW and 1100MW would be brought in. The highest before the war, he stated, was 765MW.

Exhibition of Drawing-Office Equipment at Glasgow.—An exhibition of drawing-office equipment is being presented at the Engineering Centre, Sauchiehall Street, Glasgow, by Hall Harding, Ltd., during the present week. A comprehensive range of the basic materials, tracing papers, cloths, &c., is shown, together with a wide variety of drawing-office equipment made by the company. The exhibits include drawing boards and adjustable drawing tables; photo-print room copiers, developers and cabinets, and useful sundries, such as an electric erasing machine, the "Clintax" draughting square, &c. Visitors can test the materials themselves, and if they so desire make a drawing and have demonstrations of photo-printing by the various processes exhibited by the firm.

Hard-Chromium-Plating Cylinder Liners.—At a luncheon in London on Monday last, it was announced that an agreement has been reached between the Birmingham Small Arms Company, Ltd., on behalf of its subsidiary, Monochrome, Ltd., of Redditch, and the Van der Horst Company, of Holland, under which each company will be able to use either of their two proprietary processes of hard-chromium-plating cylinder liners. The Van der Horst Company is thus enabled to operate the Monochrome "Honeychrome" process in Holland, whilst Monochrome, Ltd., will be able to operate the Van der Horst "Porus Krome" process in the United Kingdom. Under this new arrangement the combined technical resources and research facilities of both organisations, built up over many years, will operate to serve the engineering industries, and particularly manufacturers and users of cylinders and liners of all kinds. The agreement confers upon Monochrome, Ltd., the exclusive right under the Van der Horst patents to operate the "Porus Krome" process on a jobbing basis in the United Kingdom, and also confers upon the Van der Horst Company the exclusive right under the Monochrome patents to operate the "Honeychrome" process on a jobbing basis in Holland.

Personal and Business

Sir Leonard Dyer, Bart., has joined the board of Richard Crittall and Co., Ltd., 151, Great Portland Street, London, W.1.

Admiral Lord Mountevans, K.C.B., has accepted the position of chairman of Parsons Engineering Company, Ltd., Southampton.

The Minister of Transport has appointed Mr. Maurice H. Pugh to be chairman of the Transport Users' Consultative Committee for the South-east area.

The Ministry of Transport states that the address of the Road and Rail Tribunal is now 6, Spring Gardens, London, S.W.1 (telephone, Trafalgar 6782).

Saben, Hart and Partners, Ltd., design consultants, Rugby, announces that its London address is now 3–4, Albemarle Street, W.1 (telephone, Grosvenor 4666).

Head Wrightson and Co., Ltd., Thornaby-on-Tees, announces that it has taken a substantial interest in the engineering firm of Gibson Battle, Sydney, New South Wales.

Mr. Miles Beevor, at present chief secretary to the British Transport Commission, has been appointed deputy managing director of Brush Electrical Engineering Company, Ltd.

Blaw Knox, Ltd., announces that its executive offices will be moved on June 11th to 90–94, Brompton Road, London, S.W.3 (telephone, Kensington 5151; telegrams, "Blawknox, Southkens, London").

Mr. F. R. Bullen, M.I.C.E., M.I.Struct.E., Dacre House, Dean Farrar Street, London, S.W.1, announces that Mr. F. E. Fowle, A.M.I.C.E., M.I.Struct.E., and Mr. F. G. Etches, A.M.I.C.E., M.I.Struct.E., have joined him in his consulting practice. The firm will be known as F. R. Bullen and Partners.

W. H. Dorman and Co., Ltd., Stafford, states that Lieut.-Commander C. F. I. Coggins, R.N.V.R., has left this country for Australia, where he will act as the firm's Far Eastern factory representative. His address in Australia will be c/o Marine and Industrial Power Company Pty., Ltd., 205, Latrobe Street, Melbourne.

G. Percy Trentham, Ltd., informs us that it is vacating the Hillingdon office on June 16th, in order to take up new offices situated at Pangbourne, Reading, Berks; (telephone, Pangbourne 411 (five lines)). On and after the latter date all letters and communications should therefore be addressed to the Pangbourne office.

Launches and Trial Trips

Chakdina, cargo liner; built by Swan, Hunter and Wigham Richardson, Ltd., for the British India Steam Navigation Company, Ltd.; length between perpendiculars 455ft, breadth 62ft 6in, depth to shelter deck 40ft 9in, gross tonnage 7150; Swan Hunter-Doxford opposed-piston, solid-injection oil engine, six cylinders, 670mm diameter by 2320mm combined stroke, 6800 b.h.p. and 116 r.p.m., two cylindrical multi-tubular boilers. Launch, May 21st.

Athelfoam, motor tanker; built by Smith's Dock Company, Ltd., for the Athel Line, Ltd.; length between perpendiculars 430ft, breadth moulded 61ft, depth moulded 31ft, deadweight 10,300 tons on 25ft 6in draught; Hawthorn-Doxford oil engine, four cylinders, 4450 b.h.p. at 112 r.p.m., two Scotch boilers. Launch, May 22nd.

Polarbris, motor tanker; built by Barclay, Curle and Co., Ltd., for Melsom and Melsom, Norway; length 566ft, breadth 72ft 6in, depth 40ft 6in, deadweight 19,000 tons; twenty-seven cargo oil tanks, two pump rooms, four steam cargo oil pumps and steam-driven deck machinery; Barclay, Curle–Doxford airless injection oil engine, six cylinders, 750mm diameter by 2500mm combined stroke, three scavenge pumps, 1800mm diameter by 658mm stroke, two cylindrical multi-tubular composite boilers. Trial, May 22nd.

British Bulldog, steam-driven tanker; built by Swan, Hunter and Wigham Richardson, Ltd., for the British Tanker Company, Ltd.; length between perpendiculars 610ft, breadth moulded 81ft, depth moulded 44ft 6in, deadweight 28,100 tons on 34ft draught; single set of double-reduction geared turbines, by Wallsend Slipway and Engineering Company, Ltd., 13,750 s.h.p. at 116 r.p.m. at propeller, taking high-pressure superheated steam from two Babcock and Wilcox integral furnace boilers. Launch, May 22nd.

British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

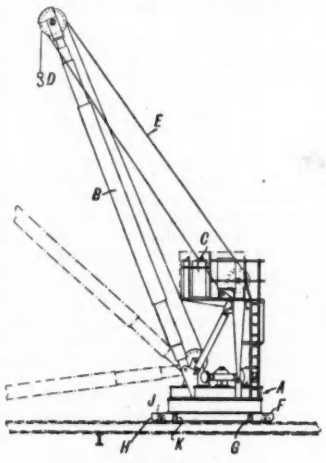
Copies of specifications may be obtained at the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 2s. each.

CRANES AND LIFTING APPLIANCES

652,459. August 6, 1948.—CRANES, Stothert and Pitt, Ltd., of Bath, Somerset; and William Coare Kinder, of "Bromley," Charlton Park Keynsham, Somerset.

This invention describes a mobile jib crane intended primarily for use as a deck crane on board ship.

The crane comprises a base *A* provided with a luffing jib *B* and control mechanism *C*. *D* represents the hook and *E* the usual luffing mechanism. The base, according to this invention, is mounted on a carriage, which consisting of pairs of intercrossing girders *F* and *G*, that project at each corner to provide an overhanging portion *H*, in which is



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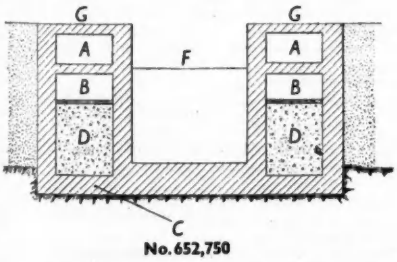
freely mounted a roller *J* or *K*, making in all two sets, each of four wheels. The wheels *J* are used to traverse athwartship, while the wheels *K* are used when the crane is travelled fore and aft of the ship's deck. Details of the deck rails and the screw jacks, which allow the rollers to be lowered or raised, are given in the specification.—*April* 25, 1951.

CIVIL ENGINEERING

652,750. January 30, 1948.—FERRY DOCKS AND LOCKS OPEN TO TIDAL WATER, Entreprise Fougerolle and Entreprise Fougerolle Pour Travaux Publics, 2, Rue Paul Cézanne, Paris, France.

The invention relates to reservoirs used in connection with ferry docks, locks and similar sea and waterway installations open to tidal water, allowing the filling of the locks with water stored at the flood. In the accompanying drawing accumulating reservoirs *A* and *B* in the form of recessed caissons are shown. There are two rows of reservoirs in the



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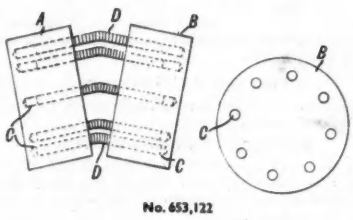
two side walls. A flooring *C* of suitable thickness ensures the proper support on the underlying ground. The recesses in the caissons form at their upper part the storage tanks *A* and *B*, while their lower part receives a ballast *D* comprising layers of gravel and sand covered by slabs. These slabs allow the construction of a floor for the lower tank to be dispensed with, without the movement of the water inside the tank resulting in a displacement of the ballast. The floor and ceiling of the upper tank *A* may be provided by a mushroom-shaped slab or by a system of small vaults, or through any other flooring system. The breadth of the caissons is such that the tanks store the whole of the volume of water required. The arrangement described makes it possible to obtain the desired operative level *F* with reference to the quay level *G* by opening in succession the gates that release the water held back in the tanks *B* and *A*, with less cost and much more speedily than with the usual system where pumps only are used. The storage tanks are fed through aqueducts provided with sluice gates. Their filling is performed at high tide and is made complete, when necessary, through pumping.—*May* 2, 1951.

POWER TRANSMISSION

653,122. July 16, 1948.—COUPLINGS FOR SHAFTS ANGULARLY DISPOSED TO ONE ANOTHER, J. Halden and Co., Ltd., of Rowsley Works, Reddish, Stockport; and Percy Hilton, of the company's address.

The invention relates to couplings of the kind used for shafts angularly disposed to one another and its object is to provide a simple and reliable coupling which can be used to transmit the motion of one rotating shaft to another working at a fixed angle to it. As shown in the drawings, two shafts *A* and *B* are to be coupled and each is drilled in the end with a series of holes *C*, all being of the same



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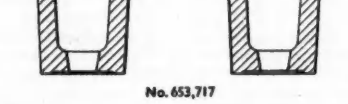
diameter and arranged in a circle concentric with the shafts and spaced equidistantly. The arrangement of the holes is the same in both shaft ends. The number of holes used may vary from three in small shafts to eight or even more for larger shafts. The shafts are placed with their drilled ends as near as possible to each other and in the holes *C* the ends of the flexible coupling pins *D* are placed, each pin entering two holes that are directly opposite. The flexibility of the pins absorbs any slight vibration set up. As the shafts rotate the pins slide in and out in the holes. If desired, provision may be made for lubricating the ends of the pins.—*May* 9, 1951.

METALLURGY

653,717. October 7, 1948.—CASTING INGOTS, Sven Lennart Wahlstrom, of Hällefors, Sweden.

The left-hand drawing shows the ingot mould *A* with an inner feeder member of sheet iron *B*, which is pendent in the mould. A frame of wood *C* to which the feeder member is connected rests upon the upper edge of the mould. The right-hand drawing shows the ingot mould *A*, the inner feeder member of sheet iron *B*, and the frame of wood *C* all within the mould, also *D* a fastening device for the feeder comprising two pieces of wood resting upon the upper part of the mould. When using the feeders, pouring is effected in the usual way. It may be suitable to interrupt the pouring when the metal has reached a part of the feeder member in



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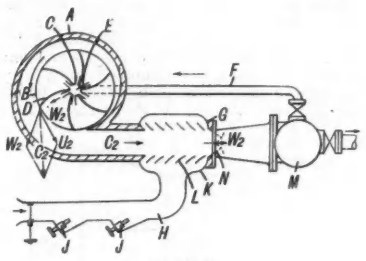
order to give the metal an opportunity to solidify between the wall of the mould and feeder member. The pouring may be continued in the next mould up to the same height and then finished in the first-mentioned mould. When the pouring of the ingot is finished the frame of wood *C* has begun to burn into charcoal. At this moment the feeder member is surrounded by an insulating layer of charcoal, which, as its burns, is heat emitting. The feeder has also a small heat capacity. Consequently the feeder action is very good and a shallow pipe is obtained extending over a considerable part of the surface of the ingot. In the specification several modifications are shown.—*May* 23, 1951.

AIR COMPRESSORS

652,749. January 26, 1948.—AIR COMPRESSORS, Willem Petrus van Lammeren, of Kniplaan 5, Voorschoten, Holland.

This invention relates to air or the like compressors, more particularly to turbine-driven compressors. As shown in the drawing, the compressor comprises a centrifugal fan *A* mounted in a housing *B* and adapted to be rotated at high speed in the direction of the arrow. One or more nozzles *C* are disposed at the centre of the fan. The number of the nozzles is preferably equal to the number of fan blades *D*. These nozzles may be connected to a ring *E* of the fan, which is rotatable, without leakage, round the feed pipe *F*. The blades of the fan are curved in the direction of rotation as shown, and because of this the resulting velocity C_2 is considerably higher than the relative velocity W_2,



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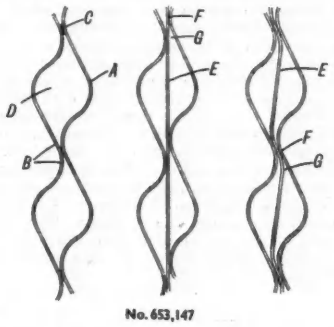
which, together with the peripheral speed U_2, forms the component of the velocity C_2. By suitable shaping of the housing *B* the air is conducted to an injector *G*. The air to be injected enters the tube-shaped chamber *H* through the inlet funnel and is entrained by the circulating air. The chamber is provided with burners *J* suitable for liquid fuel. They may be replaced by cooling means, when expedient. The chamber is connected to a chamber *K*, in which the injector vanes *L* are arranged coaxially to one another. A tapered pipe is provided between the chamber *K* and the tank *M* so that the exhaust is connected to the tank, to which also the outlet pipe, with its stop cock, and the circulating pipe, with its stop cock, are connected. Between the tapered pipe and the injector chamber *K* an automatic non-return valve *N* which opens in the direction of the arrow is provided.—*May* 2, 1951.

HEAT EXCHANGERS

653,147. September 23, 1948.—TUBES FOR HEAT EXCHANGERS, Andre Huet, of 48, Avenue du President Wilson, Paris, France.

This invention relates to multiple-tube units or bundles employed in apparatus for the exchange of heat between fluids. Each tube unit or bundle, according to the invention, is formed, as shown in the drawing, of two sheets shaped by pressing to provide alternating arcuate section tube wall portions *A* in fin forming portions *B*, the sheets being arranged with the fin-forming portions of one sheet opposing, and in contact with, those of the other



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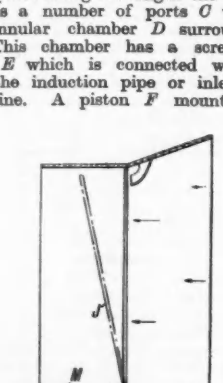
sheet and secured along the lines of contact. Preferably the sheets are seam welded, as indicated at *C*. Tubes *D* are thereby formed. To increase rigidity, there may be interposed between the tube wall and fin-forming sheets a reinforcing sheet *E*. Such a sheet may be a plain flat sheet or it may be waved or undulating, as seen in the drawings. In tube units so constructed the fin portions of the tube wall and fin-forming sheets contact with the reinforcing sheet *E* and are seam welded as indicated at *F*. The fins are substantially tangential to the tubes, and the outer sheets are so shaped that

hollow spaces *G* are formed between them and the reinforcing sheet at the base portions of the fins. Due to the fins being hollow, at least at their base or root portions, they not only possess a considerable degree of rigidity, but give a rapid exchange of heat between the internal and external fluids at the root portions owing to the small quantity of internal fluid present between the walls of the fins.—*May* 2, 1951.

INTERNAL COMBUSTION ENGINES

653,210. October 1, 1948.—Extra Air Admission Devices for Internal Combustion Engines, Kenneth Spencer Labrum, of 30, Greenford Avenue, Southall, Middlesex.

According to the invention, an extra air valve is provided which is connected to the induction pipe or inlet manifold of an internal combustion engine, and which includes means, responsive to the speed of the engine, for automatically controlling the opening of the valve. In the drawing the valve comprises a cylinder *A* which is open at one end and closed at the other end by a screwed plunger *B*. At a point along its length the wall of the cylinder has a number of ports *C* which open into an annular chamber *D* surrounding the cylinder. This chamber has a screwed outlet connection *E* which is connected with a port drilled in the induction pipe or inlet manifold of the engine. A piston *F* mounted in the



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cylinder is arranged to close the ports through the action of a compression spring *G*. Attached to the open end of the cylinder is a short metal funnel *H* closed by means of a flap *J* which is pivoted in the funnel at its lower edge. A lever arm *K* extends rearwards from the flap and is connected with the piston by an operating rod *L*, one end of which is engaged by a recess *M*, while its other end is fitted in a recess *N* drilled in the end of the piston. A stop is provided for limiting the movement of the flap. When the engine is stopped or when it is running at a very low speed, the compression spring holds the piston in its upper or closed position, in which it covers the ports in the cylinder and prevents the admission of any extra air to the engine. In this position of the piston the flap is held in its forward position. As the speed of the engine is increased, the pressure of the air acting on the flap will also increase until the flap is forced backwards, thus depressing the piston in the cylinder against the force of the spring until it uncovers the ports. This permits extra air to be drawn into the induction manifold through the cylinder. The greater the speed of the engine the more the piston will be depressed and the greater will be the amount of air admitted.—*May* 9, 1951.

The Society of Chemical Industry.—The annual general meeting and dinner of the Chemical Engineering Group of the Society of Chemical Industry were held at the Waldorf Hotel, London, on Wednesday, May 23rd. Mr. H. V. Potter was appointed to succeed Mr. N. C. Fraser as Chairman of the Group. At the dinner the toast of "The Society and Guests" was proposed by the chairman and was responded to on behalf of the Society by Mr. Stanley Robson, President, and on behalf of the guests by Mr. H. A. R. Binney, Director of the British Standards Institution.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Incorporated Plant Engineers

Tues., June 12th.—E. Lancs Branch: Engineers' Club, Albert Square, Manchester, "Maintenance of Industrial Instruments," 7.15 p.m.

Thurs., June 14th.—Newcastle upon Tyne Branch: Roadway House, 8, Oxford Street, Newcastle upon Tyne, "Industrial Photography," 7.30 p.m.

Institute of Industrial Administration

Wed., June 13th.—Fyvie Hall, The Polytechnic, Regent Street, London, W.1, "Company Control," T. G. Rose, 6.30 p.m.

Institute of Petroleum

Thurs., June 21st.—Royal Institution, Albemarle Street, London, W.1, "Competitive and Co-operative Research in the American Petroleum Industry," Robert E. Wilson, 4.30 p.m.

Institute of Road Transport Engineers

To-day, June 8th.—S. Wales Group: Visit to the works of the Homerton Rubber Company, Ltd., Treforest Trading Estate, Glam, 7 p.m.

Wed., June 20th.—London Branch: Visit to the works of Zenith Carburetter Company, Ltd., Stanmore, Middlesex, 2 p.m.

Institution of Civil Engineers

To-day, June 8th.—Yorkshire Association: Visit to Woodhead tunnel.

Institution of Production Engineers

Tues., June 19th.—Wolverhampton Graduate Section: Technical College, Wolverhampton, "Industrial Economics," C. Tragen, 7.30 p.m.

Joint Engineering Conference

To-day, June 8th to Fri., 15th.—Meetings at Institution of Civil Engineers, Great George Street, Westminster, S.W.1; Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1; and Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. For details of arrangements see The Engineer, May 18th, page 662.

Old Centralians

Thurs., June 14th.—Chez Auguste Restaurant, Frith Street, London, W.1, "Anglo-American Productivity," B. White, 12.55 p.m.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 24, Victoria Street, London, S.W.1.

CAST IRON COLUMNS FOR STREET LIGHTING

No. 1249 : 1951. This revised British Standard supersedes the previous issue, which was published in 1946 and now takes into account recent improvements in the design of cast iron columns for street lighting. The strength of the columns is ensured by a deflection test and detailed dimensions of a suggested design are given.

The main difference between this revision of B.S. 1249 and the 1946 issue is that detailed designs of the decorative mouldings have been deleted and a 15ft mounting light column, without a door, has been included. Price 2s., post free.

THERMODYNAMIC PROPERTIES OF REFRIGERANTS

No. 1725 : 1951. This standard gives tables of thermodynamic properties of the following refrigerants: ammonia, sulphur dioxide, carbon dioxide, methyl chloride and dichlorodifluoro methane. The properties of saturated vapour and superheated vapour for each refrigerant is given; the tables of properties of carbon dioxide have been obtained from sources in this country and those of the remaining refrigerants from data published in the United States of America. An appendix gives references from which details of the properties of refrigerants not covered by the standard can be obtained. Price 10s. 6d., post free.

COLOUR IDENTIFICATION OF PIPE-LINES

No. 1710 : 1951. Three British Standards have been published during the last twenty years dealing with the identification of piping. In order to remove anomalies and to co-ordinate requirements, this new code has been prepared and replaces B.S. 457, "Identification of Chemical Pipe-Lines"; B.S. 617, "Identification of Pipes, Conduits, Ducts and Cables in Buildings"; and B.S. 3011, "Identification Colours for Engine-room Piping." It does not supersede British Standards dealing with gas cylinders, medical gas cylinders, nor does it affect the provisions of B.S. 158 dealing with identification of switchgear, busbars, connections and wire.

Primary identification colours indicate the class of content in pipe-lines applied either along the length of the pipe or in broad rings. Appendices give particulars of detailed identification of contents by various methods. Coloured illustrations of the application of the code are included. Price 2s. 6d., post free.

WATER-TUBE BOILERS AND THEIR INTEGRAL SUPERHEATERS

No. 1113 : 1951. This British Standard, which was first published in 1936, forms one of a series for land boilers. The present edition is an extensive revision of the 1936 edition. New provisions to bring the standard into line with present-day practice have been included, notably that for stand-pipes fabricated and secured to the boiler shell by fusion welding. The general intention to avoid the use of complicated formulæ has been realised by confining consideration to the types of water-tube boilers in general use. It is stipulated that the calculations made to determine the scantlings shall be based on the design pressure, which shall be not less than the highest pressure at which any safety valve is to be set to lift. Requirements for materials such as plates and rivet bars are those given in B.S. 1633, "Steel for Land Boilers, Receivers and Other Pressure Vessels," but with the addition of a clause relating to the defacing of material failing to satisfy the tests.

This British Standard applies solely to water-tube boiler units, including superheaters and economisers and the other parts connected thereto without the interposition of a shut-off valve, exclusive of brickwork setting and insulation. The boilers are required to be complete with mountings constructed in accordance with B.S. 759, unless they are specifically excluded in the enquiry and order. It is recognised that the design of water-tube boilers is the subject of continuous development and it is intended to review this standard as necessary. Price 12s. 6d., post free.

DIMENSIONS OF SMALL RIVETS FOR GENERAL PURPOSES

No. 641 : 1951. This revised standard supersedes the 1935 edition. It specifies the dimensions of small rivets, such as snap, pan, mushroom, flat and countersunk headed rivets of nominal diameters below ½in for general purposes and the dimensions of countersunk head rivets—140 deg. (hose rivets) and reaper rivets. The dimensions of washers for use with 140 deg. countersunk head rivets (hose rivets) are also included.

It covers small rivets made from mild steel, copper, brass and aluminium alloys and pure aluminium. Details of Coopers' flat-head rivets ½in diameter and below are given in an appendix. Tables giving the nominal sizes of rivets which are readily obtainable from stock are also included. Price 2s. 6d.

Catalogues

W. H. Dorman and Co., Ltd., Stafford.—Catalogue No. 738, describing "Flexstel" universal ball and socket pipe joints.

Frederick Parker, Ltd., Viaduct Works, Catherine Street (Extension), Leicester.—Abridged catalogue of plant manufactured.

Evershed and Vignoles, Ltd., Acton Lane Works, Chiswick, London, W.4.—List No. 248, describing operation recorders.

Air Control Installations, Ltd., Ruislip, Middlesex.—Folder No. H 509, "Direct Humidification for the Textile Industry."

Suffolk Iron Foundry (1920), Ltd., Sifbronze Works, Stowmarket.—Leaflet giving full details of the Sifbronze regulator.

Richard Sutcliffe, Ltd., Universal Works, Horbury, Wakefield, Yorkshire.—Literature describing mechanical handling equipment.

Pegson, Ltd., Coalville, Leicestershire.—Brochure giving details of the range of pumps for industrial use and for contractors.

Paul Grandy and Co., 30, Parkside, Knightsbridge, London, S.W.1.—Booklet dealing with presses for forge-masters and stampers.

Morgan Crucible Company, Ltd., Battersea Church Road, London, S.W.11.—Publication SD.36, "Hints on Design for Morganite Reservoil," and F.D.5., "Morgan Lift-Out Crucible Furnace."

W. Edwards and Co. (London), Ltd., Worsley Bridge Road, Lower Sydenham, London, S.E.26.—Bulletin giving details of high-vacuum equipment for hospitals and medical research.